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Evaluation and development of computer based teaching and feedback: Strathclyde Computerised Randomised Interactive Prescription Tutor (SCRIPT)

by

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Declaration

‘This thesis is the result of the author’s original research. It has been composed by the author and has not been previously submitted for examination which has led to the award of a degree.’

Signed:

Date:

Abstract

Aim

Strathclyde Computerised Randomised Interactive Prescription Tutor (SCRIPT), an e-learning program, was designed as a revision tool for an undergraduate competency based pharmacy practice class. SCRIPT has been developed and evaluated over four years. SCRIPT started as a standalone revision tool, and was developed to become an integrated teaching and revision tool, following the principles of Supplemental and Replacement models (Twigg, 2003), and as an optional resource to support pre-registration trainees. This thesis describes the use and perceptions of SCRIPT during each stage of development.

Methods

Student use of SCRIPT was determined through log file analysis at all stages of the evaluation. Descriptive statistics were used to compare the access patterns observed from each cohort. Student perceptions were determined through online questionnaires and semi-structured interviews and staff perceptions were sought through interviews.

Results

SCRIPT was used extensively over three years of undergraduate education. The greatest remote use was seen following Supplement integration; 4882 attempts per 100 students over the year. Students predominantly accessed SCRIPT during normal waking hours and in the run up to class assessments. This was consistent at all stages of the evaluation. There were differences in use patterns observed between the Home and Collaborative students. A number of refinements to SCRIPT were made in response to the feedback from students and staff. SCRIPT was used less frequently in pre-registration training. A need to review the most appropriate way to use SCRIPT during this stage of pharmacy education was identified.

Conclusions

SCRIPT has been a helpful learning aid for pharmacy students and there is scope to develop the tool further into pre-registration training. Future developments should remove ambiguity in the program and increase staff engagement. Future research should compare SCRIPT use and perceptions in other Schools of Pharmacy.

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Glossary

Abbreviation	Text in full
4C / ID	Four Component Instructional Design
BNF	British National Formulary
CAL / CAI	Computer Aided Learning / Instruction
CD	Controlled Drug
CMS	Content/Course Management Systems
CMS	Chronic Medication Service
CPD	Continuing Professional Development
CWA	credit weighted average
EEA	European Economic Area
GPhC	General Pharmaceutical Council
IMU	International Medical University
LMS	Learning Management System
MAS	Minor Ailment Service
MEP	Medicines Ethics and Practice
MPharm	Masters of Pharmacy
NES	NHS Education for Scotland
NHS	National Health Service
OSCE	Objective Structured Clinical Examination
OSPAP	Overseas Pharmacists' Assessment Programme
PASW (SPSS)	Predictive Analytics SoftWare (Statistical Package for the Social Sciences)
PLATO	Programmed Logic for Automated Teaching Operations
PRPS	Pre-Registration Pharmacist Scheme
REAP	Reengineering of Assessment Practice
RPSGB	Royal Pharmaceutical Society of Great Britain
SCRIPT	Strathclyde Computerised Randomised Interactive Prescription Tutor
SOPHIE	SOPHisticated Instructional Environment
SPIDER	Strathclyde Personal Interactive Developmental Educational Resource
VLE	Virtual Learning Environment

Assessment day
A day of the week on which the competency based class assessments were conducted. This does not take in account the number of assessments on that day.

Credit weighted average (CWA)
The average performance of an individual student based on their performance in all classes, weighted according to the number of credits associated with each class. Classes reported as either pass or fail, such as the competency based class, are excluded from the CWA.

Collaborative subgroup
These students completed five semesters of the MPharm degree at the International Medical University in Kuala Lumpar, Malaysia and a compressed summer semester at the University of Strathclyde, before continuing into the final year of the MPharm at the University of Strathclyde.

ePortfolio
An electronic portfolio designed to support learning within the NHS. It provides a means of communications, a secure record for evidence collection, and a repository of information. NES use this to administer and support the Pre-Registration Pharmacy Scheme (PRPS).

Home subgroup
Students who were undertaking the competency based class in year three of the four year MPharm degree course. The competency based class was taught over two traditional academic semesters. This subgroup comprised:

- Students who undertook all 4 years at the University of Strathclyde, and

- Students who, at the time of the study, had completed two years of study at the International Medical University in Kuala Lumpar, Malaysia and were starting the first of two years at the University of Strathclyde: these were the **Home (2+2)** students.

Home (2+2) subgroup
Students from the Home subgroup who, at the time of the study, had completed two years of study at the International Medical University in Kuala Lumpar, Malaysia and were starting the first of two years at the University of Strathclyde.

In class use of SCRIPT
This refers to the use of SCRIPT during a taught class, with one or more students viewing the computer screen. For the Home subgroup one third of the class had access to SCRIPT on Mondays, Tuesdays or Wednesdays. For the Collaborative cohort, the whole class had access to SCRIPT on Mondays, Wednesdays and Fridays; with 50% in the morning and 50% in the afternoon.

Replacement cohort
In academic year 2009 – 2010 SCRIPT was available in the same way as Supplemental use with the addition of being available during teaching.

Replacement practical lab
The practical lab ran in the same format as in the Supplemental year: six groups of students, each of which received a different scenario every 30 minutes. In the Replacement year one of the six scenarios was replaced with a SCRIPT station.

Remote use of SCRIPT
This refers to the use of SCRIPT at any time outwith the taught class. SCRIPT was available 24 hours a day to all students in both cohorts and remote use reflects students' use in their personal time, as chosen by the students. Students were advised that SCRIPT was available but were not required to or expected to log into the program.

SCRIPT Editorial team
The team responsible for the maintenance and development of SCRIPT. These members of staff had editorial rights to allow editing and addition of scenarios and tests, and access to the SCRIPT email helpline. The SCRIPT editorial team during this study were, Dr Anne Boyter (Senior Lecturer, co-founder of SCRIPT and PhD Supervisor), Ian Thompson (Computer officer and co-founder of SCRIPT) and Leon Zlotos (Teacher Practitioner/NES Practice Education Co-ordinator and PhD Student).

SPIDER
Strathclyde Personal Interactive Developmental Educational Resource (SPIDER) is a web-based virtual learning environment used to support the MPharm degree. SCRIPT was hosted on SPIDER and was accessible through the class code for the competency based class.

Supplemental cohort
In academic year 2008 – 2009 SCRIPT was used as a supplemental program which was available to students remotely 24 hours of the day. The scenarios were grouped and released to correspond with the taught course.

Supplemental practical lab
The practical lab in the competency based class ran for a three hour period, during which six groups of students were allocated one of six practical scenarios to work through in a 30 minute period and then rotate through all six scenarios.

Test of the week
The group of scenarios aligned to the taught class which was release in a particular week or week equivalent.

Week (Academic Week)
The week in relation to the academic timetable.

Week Equivalent (Academic Week)
The time period during the compressed Collaborative timetable that was equivalent to the academic week of the Home timetable. One week was equivalent to Monday and Tuesday, Wednesday and Thursday, or Friday, Saturday and Sunday of the compressed timetable.

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Chapter 1

Introduction

1.1 e-Learning Background

In 1943, Thomas Watson, the Chief Executive Officer of IBM, is claimed to have said that "*there is a world market for maybe five computers*" (Masters & Ellaway, 2008). However, in 2009 there were worldwide sales of 306 million personal computers and 172 million smart phones and in 2010, Apple and Microsoft fought for the title of most valuable technology company; each valued at over 220 billion US dollars (Helft & Vance, 2010). The increasing use and availability of computers in everyday life has, not surprisingly, led to their use to support education: an evolution that has been described as an "*accidental revolution*" (Molnar, 1997).

Nicholson (2007) suggests that the roots of e-learning may lie as far back as the 1960s as early pioneers such as Patrick Suppes and Don Bitzer foresaw the future of technology in education. Patrick Suppes from Stanford University researched the role of computers in education, albeit, limited by the functionality and high cost of the technology available at the time. Suppes prophesised that computers would be integral in University education and that they would fulfil the role of a personal tutor to all students offering diversity in education that would accommodate a wide range of cognitive and learning styles (Suppes, 1966). Suppes was able to demonstrate the value of computers in education, predominantly due to the provision of rapid feedback and the self paced nature of the programs used (Molnar, 1997).

Don Bizter from the University of Illinois developed the computer system, PLATO (Programmed Logic for Automated Teaching Operations), which was designed to support students who needed to improve their literacy, but in addition allowed communication through electronic notes. PLATO was the precursor for the synchronous and asynchronous messaging systems that are widely used today and has been described as a direct ancestor of commercial Virtual Learning Environments (VLEs) such as Blackboard™ and WebCT™ (Nicholson, 2007).

In the 1970s, computers became more advanced as did their application in supporting education. Carbonell's (1970) SCHOLAR system was described as a form of Artificial Intelligence because it contained a network of facts, concepts and procedures, which allowed students to ask open questions and hold a conversation with a computer. This was different to previous programs which required educators to develop "frames" of information with anticipated questions and answers, meaning that the interactions were limited. Another example of advancing computer software from the 1970s was John Selly Brown's SOPHIE (SOPHisticated Instructional Environment). This was a simulation program which allowed students to develop and test their knowledge and problem solving skills associated with modelling electronic circuits (Brown *et al,* 1975; Molnar, 1997). The key message is that technology was evolving and educators were keen to use computer technology in imaginative ways to advance their teaching practice. This is no different to the use of more basic technologies, such overhead projectors, with educators finding innovative ways use the tools at their disposal to increase efficiency and improve educational experience and outcomes (Ellaway & Masters, 2008).

These examples of early computer based education highlight the start of e-learning as we know it today. The programs of the 1970s and early 1980s predominantly adopted a simplistic "drill and practice approach" to education but these soon evolved due to advances in multimedia technology. This saw the emergence of constructivist approaches to education which were adopted with the support of technology in the 1990s (Nicholson, 2007). At the turn of the century, Molnar (1997) reported that "*increasingly many concepts and ideas cannot be taught without the aid of technology*". Now in the 21st Century, social media and open source software allow almost anyone to participate in education through the internet and computers are beginning to be superseded by mobile technology such as smart phones and tablet devices.

The terminology associated with the use of computers in education has also evolved and this may cause confusion. Early terms such as Computer Aided Learning/Instruction (CAL/CAI) and Multimedia learning were commonly used. After the introduction of the internet the terms web-based and internet-based learning emerged. More recently "e-learning" has become an all encompassing term for the use of technology for educational purposes, with "m-learning" referring to learning that requires the use of mobile devices rather than computers.

Given the variety of both technological and pedagogical approaches available to date, it is clear that e-learning is a very broad term. It encompasses, Virtual Learning Environments (VLE), Learning Management Systems (LMS), Content/Course Management Systems (CMS), synchronous and asynchronous communication, ePortfolios, eAssessments, and programs designed with specific learning outcomes in mind. Such programs include simulations and games. All of these tools provide content and / or a process to enable learning to take place (Ellaway & Masters, 2008) making e-learning a difficult term to define.

Resources can be subcategorised into the use of technology to deliver educational instruction at a distance and the use of computers and the internet to deliver standalone multimedia packages (Gensichen *et al*, 2009). However, Clark & Mayer (2008), highlight that the definition of e-learning must include the three key elements: the what, the how and the why. The what, being the content and the instruction methods used to engage learners in the content. The how, being the instructional make up of the resource, including the use of spoken or written text, illustrations and animations, and whether the learning is delivered synchronously (in real time) or asynchronously (with a time delay). Finally, the why, is the driver of learning which is either the learner who seeks self directed learning outcomes or the organisation which focuses on the bottom-line goal. With these key elements in mind, Clark & Mayer (2008) propose that e-learning is:

"*Instruction delivered on a computer by way of CD-ROM, internet or intranet with the following features:*

- *Includes content relevant to the learning objective*
- *Uses instructional methods such as examples and practice to help learning*
- *Uses media elements such as words and pictures to deliver contents and methods*
- *May be instructor-led (synchronous e-learning) or designed for self-paced individual study (asynchronous)*
- *Builds on new knowledge and skills linked to individual learning goals or to improve organisational performance*".

Ellaway & Masters (2008), take a more holistic view of e-learning, which allows for the ad hoc use of technology, suggesting that "*true e-learning is what the student actually does*". Similarly Bernard *et al* (2004) state that *"the medium becomes the tool of the learner's cognitive engagement and not simply an independent and neutral means for delivering content. It is what the learner does with a medium that counts, not so much what the teacher does"*. These perspectives emphasise the observation that e-learning "*means different things to different people*" (Nicholson, 2007). However, learning is common to all these definitions and as such it is possible that the terms e-learning and m-learning will disappear as technology becomes a key part of learning in general (Masters & Ellaway, 2008).

Implementation of e-learning - considerations

There are a number of reported advantages and disadvantages associated with the use of technology in learning and there is a need to consider potential barriers and benefits before deciding if e-learning is appropriate in a particular context. Financial and time commitments required for set up are particularly important. These may be linked to hardware and software procurement, the cost of programming and general administration of both technical and subject specific content (McKimm,

2003; Masters & Ellaway, 2008). Open source software may reduce procurement costs compared to obtaining licences for commercial software, however, there is a time commitment associated with the programming required to adapt this software to meet institutional requirements (Masters & Ellaway, 2008). A review of e-learning barriers and solutions advises that any hardware or software should be future proofed and that cost-benefit analysis and programme evaluation should be incorporated into implementation plans and budgets (Child *et al,* 2005). Other practical considerations include the space required for computer terminals, network connectivity, the availability of adequate power supply and the security of equipment and data. Although the bandwidth of network connections in a University may be adequate, consideration must be given for users' who choose to access e-learning remotely, which may be via cable or wireless networks of variable download speeds. File size and media format may be influenced by the download speed available. Another technical consideration is compatibility with existing IT infrastructure, such as avoiding conflicts with institution firewalls (Masters & Ellaway, 2008).

e-Learning has to be accessible to all users and must also cater for the IT experience of the user. Although IT skills may not be perceived to be a problem in undergraduate education, care must be taken in case there are users who require special access requirements and additional education to permit them the same accessibility as other users. This applies to both staff and students (Masters & Ellaway, 2008). In addition, although computer literacy may not be an issue for a learner, there needs to be consideration for the costs imposed on the learner, if for example they are required to purchase their own equipment to access material remotely (Childs *et al,* 2005). There is also a requirement for ongoing support which may include an introduction session for new staff and students, accessible frequently asked questions, and some form of helpline. This support should cover both technical and content aspects of e-learning and there should be provision made for out of hours support (Masters & Ellaway, 2008).

Social isolation of some students can be a disadvantage of e-learning (McKimm, 2003) and poor instructional design can be harmful to learning (Cook, 2006; Clark & Mayer, 2008). As such, not only is there a cost associated with the initial set up and programming but care must also be taken to ensure that guidelines on best practice are consulted before implementing e-learning. The choice to implement an e-learning resource should be based on a desired education purpose and not for the sake of using technology (Clark & Mayer 2008).

Staff education and engagement is key to the success of e-learning implementation. This can be troublesome given that the majority of staff who support education may not have been involved in programme development or selection. Educators involved in the implementation of e-learning need to consider change management strategies to encourage a cultural shift from staff involved in delivery (Childs *et al,* 2005). Securing acceptance and commitment from staff is essential to the successful uptake of e-learning programs (Cook & Dupras, 2004) and offering rewards may help overcome this barrier (Greenhalgh, 2001). There is strong evidence that suggests that staff engagement can be lost if there are unclear messages from management with regards to the use of and evidence for inclusion of e-learning. This message can be clarified through piloting and ongoing evaluation. Collaboration with staff during planning, piloting and evaluation may help engage staff in the change in practice being proposed (Childs *et al,* 2005).

Careful consideration of methods to overcome these potential barriers can result in effective e-learning which has a number of benefits including; reduced staff time and paper work (Cook, 2006), remotely accessible content which can be self directed and self paced according to the learners' needs at a time that suits the learner (McKimm, 2003), increased flexibility for different part-time or work based learners (McKimm, 2003; Cook, 2006), provision of rapid and up to date feedback (McKimm, 2003), easily updatable content (Cook, 2006), and delivering a consistent

message (Cook, 2008). Teachers are able to monitor learning activity and assess learning outcomes, while learners experience greater flexibility and interactivity compared to traditional large group education (Maxwell & Mucklow, 2012). Faculties can integrate e-learning in to existing curricula, in a number of formats, without the need for complete overhaul (Twigg, 2003). This can lead to increased variety in the learning resource formats available to learners (McKimm *et al,* 2003), some of which may be individualised to the preferences and needs of learners (Cook, 2006).

Evidence for the use of e-learning

There have been four key reviews of e-learning research that provide evidence to support the use of e-learning as an alternative to traditional educational methods. Two of these are general (Bernard *et al*, 2004; Tallent-Runnels *et al,* 2006) and two relate to the education of health professionals (Chumley-Jones *et al*, 2002; Cook *et al* 2008).

Bernard *et al,* (2004) conducted a systematic review and meta-analysis of 232 studies of technology enhanced distance education. Although there was significant heterogeneity between the studies in this review the authors state that e-learning can be comparable to traditional instructional methods. The authors suggest that future research should focus on determining why e-learning works and in what circumstances rather than trying to prove the worth of e-learning in general. Tallent-Runnels *et al*, (2006), who reviewed 76 studies comparing online course delivery to traditional course format, reported similar findings to Bernard *et al*, (2004). Both of these reviews validate the option of e-learning but they also highlight the need for educators to adopt good instructional design of courses regardless of the medium or method of delivery.

In terms of e-learning to support health professional education Chumley-Jones *et al*, (2002) report that e-learning can improve knowledge gains compared to no

educational intervention and result in similar knowledge gains when compared to traditional educational methods. The authors also report positive attitudes of learners towards the use of e-learning and they indicate a number of factors that can influence learner satisfaction, such as accessibility and download speed. However, the review was limited to studies of medical, dental and nursing students, with learners from different educational stages, and therefore the findings may not be representative of all health care professionals or at all stages of their education. In addition, the lack of standard terms for describing e-learning or web-based learning made literature searching challenging. The authors concluded that e-learning may be a "*valuable addition to our educational armory, but it does not replace traditional methods*" and that "*poorly designed educational programs or materials are not improved by being presented on a web page*". This indicates the importance of good instructional design which was also reported Bernard *et al*, (2004) and Tallent-Runnels *et al*, (2006).

Cook *et al*, (2008) conducted two systematic reviews to quantitatively summarise the effects of internet-based instruction in health professional education, compared to no intervention and traditional educational interventions. The authors note a number of limitations to their study including diversity in the study topics, contexts, instructional designs, and outcome measures of the original papers. A large number of studies of computer aided learning interventions were excluded because they were not internet-based. Despite these limitations the authors report similar conclusions to Chumley-Jones *et al*, (2002) that in health professionals, internet-based education can have a positive effect on learning outcomes compared to no educational intervention and similar effects to traditional educational methods.

Cook (2009) from the Mayo Clinic, Minnesota, highlights a flaw in current research into the use of technology to enhance learning. Using the analogy of a comparison between a horse and cart and a car, Cook advises that only so much can be learned from comparisons of e-learning with traditional educational methods. It is clear that

e-learning can have a beneficial effect when compared to no intervention, but less so when compared to a well designed traditional curriculum. As such Cook reiterates the advice of Bernard *et al*, (2004) by recommending that future research has to compare e-learning with e-learning to determine "how" and "when" to use technology rather than the "if" to use it. The focus of future research should be to advance e-learning, within specific contexts, rather than trying to prove the global worth of e-learning in general (Cook, 2009).

It is clear from these reviews that e-learning can be a suitable alternative to traditional educational methods. However, this requires consideration of good education practice and instructional design principles.

1.2 Learning and Educational theories

It is important to consider how people learn when planning an educational programme or course, whether this is face to face or with the aid of technology. Although some theories may be applicable to both formats of education there are specific considerations which are particularly relevant when using technology to aid learning.

Learning and education are often used interchangeably but there are differences. Education implies an activity that is intended to influence a change in knowledge, skills and/or attitude, thus the perspective is that of the educator. Whereas learning, from the perspective of the learner, is the process by which knowledge is created or a change in behaviour, skill or attitude is acquired (Knowles *et al*, 1998). In the context of e-learning, education may be designed and standardised with particular objectives in mind, whereas some e-learning may be developed for self directed learning and may be used differently by different learners. This leads to the debate of learning objectives as opposed to learning outcomes. Again two terms that are used interchangeably, but objectives are what the educator wants the learner to achieve whereas outcomes are what the learner actually achieves, which may be individual to the learner (Fry *et al*, 2003).

A number of learning theories have been described in the literature and many interpretations have tried to rationalise the theories into broad categories, although there is no universally accepted classification system. Knowles *et al*, (1998) highlight the difficulties associated with categorising learning theories, with classification systems ranging from eleven categories to systems with only two types of theory: those relating to association / stimulus response and field theories. However, although the terminology may vary, the majority of theories fall into behaviourist, cognitivist or constructivist categories (Knowles *et al*, 1998; Svinicki, 1999; Harrison, 2009). These are defined as whether learning is considered to be a change in behaviour in response to events within the learning environment (behaviourist); if

learning is viewed as a change in memory or cognitive function (cognitivist); or if knowledge is actively constructed by the learner based on past and present experiences (constructivist) (Knowles *et al*, 1998; Svinicki, 1999; Harrison, 2009).

Behaviourist theories

Behaviourist theories include Thorndike's connectionism, which suggests that responses are connected to specific stimuli or rewards and Pavlov's classical conditioning, based on the salivation response to conditioned and unconditioned stimuli. Operant conditioning, from Skinner's work with pigeons and rats, and Guthrie's contiguity theory based on the effects of groups of stimuli all fall into this category (Knowles *et al*, 1998). In a broad sense these theories relate to the development of a learned response to a specific stimulus through reward or punishment depending on whether the response was desirable or not. This type of conditioning is designed to train the individual to develop the desired behaviours or traits while eliminating undesirable responses before they become habit. Educational approaches that are aligned to these theories place the learner in a passive position during the learning process (Harrison, 2009). Courses designed with behaviourist principles require clear, objective outcomes that may be segmented to allow the learner to develop progressively. Although the learner is relatively passive, behaviourist courses are often self-paced and rely on immediate feedback to punish or reward performance (Svinicki, 1999). These characteristics can be easily achieved through e-learning instructional design (McKimm, 2003).

Cognitivist theories

Cognitivist theories focus on the acquisition, storage and organisation of knowledge, which results in the development of cognitive knowledge structures, called schemata (Svinicki, 1999). Cognitivist theories rely on the learners' ability to apply knowledge to similar or dissimilar situations, enforcing or adapting their understanding depending on their success or failure. With each problem solved the learner's knowledge broadens, allowing greater application to new, more complex

problems. There are three types of responses a learner may have to new information: assimilation – where the learner accepts the new knowledge because it is consistent with the their pre-existing cognitive framework; accommodation – where new information is adapted to fit into the learners pre-existing cognitive framework and; rejection – where the learner does not accept the new knowledge because it is too different to their existing cognitive framework (Harrison, 2009). Although early cognitivist approaches primarily focussed on presenting information to aid storage and organisation, instructional design began to reflect a more learner-centred approach, to encourage the learner to direct the learning process. Courses developed from a cognitivist approach were likely to include methods of presenting information to aid organisation, including; highlighting key points, signifying the relevance of the new knowledge to the learner, incorporating methods of checking understanding and a consideration for the capacity of the learner's working memory. To encourage learners to direct their own learning, strategies to enhance their metacognitive skills, such as cognitive apprenticeship, were also considered (Svinicki, 1999).

Constructivist theories

The move to learner centred learning prompted the development of constructivist approaches where the learner takes precedence in the learning process. Based on Piaget's work on childhood development, the constructivist theories assume that adult learners have their own construct of the world, which influences the way that they deal with new information, based on experience, feelings, beliefs and values. (Svinicki, 1999; Fry *et al,* 2003; Harrison, 2009). Based on this, constructivism suggests that learning is context bound and that new knowledge must be related to existing knowledge to ensure that is retained. Thus, the process of unlearning becomes important as new knowledge and understanding may contradict previous beliefs. Therefore the learning process must go through three stages. The first is "unfreezing", which involves the learner challenging their existing schema, before the second stage in which they can make changes to their cognitive framework

before the final stage of refreezing and incorporating what has been learned (Knowles *et al*, 1998). Collaboration among learners has been noted as "*a potent way in which an individual learner forms an interpretation of the environment and develops understanding*" (Svinicki, 1999). Courses developed using a constructivist approach may encourage self-regulation so that learners set their own goals, choose their own strategies for learning and monitoring their own progress. In addition, problems should be similar in nature and complexity to real life, and learners can be encouraged to learn in groups because *"in working with others to understand material, the learners have more open access to their own understanding and thinking processes"* (Svinicki, 1999). Bangert (2004) highlights the importance of using constructivist learning approaches to guide the development of e-learning.

E-Learning metaphors of learning

Clark & Mayer (2008) describe three metaphors of learning in the context of e-learning, in which the principles of the behaviourist, cognitivist and constructivist views are evident. The response strengthening metaphor resembles a behaviourist view in that the learner is in the passive position, receiving rewards or punishments depending on their performance. In the information acquisition metaphor, the learner passively receives information from a teacher, which reflects the cognitivist theories of learning. Finally the knowledge construction metaphor is used to describe learning that requires active participation from the learner, to build on their own knowledge, with the teacher acting as a guide or facilitator. Here the constructivist views are evident. Clark & Mayer, use these metaphors to emphasise that the nature of e-learning instructional design and architecture can influence the type of learning that may occur.

Pedagogy and Andragogy

The design of an educational programme should reflect the stage of learner development and Knowles *et al*, (1998) define clear differences between learning in

children and adults. The terms pedagogy, "the art and science of teaching children", and andragogy, "the art and science of helping adults learn" (Fry *et al,* 2003) are now commonly used to highlight these differences. Knowles *et al*, (1998) note that as people mature they take more control of learning which leads to six key assumptions (Table 1.1).

Table 1.1 Six key assumptions of adult learning (adapted from Knowles *et al*, 1998)

Key assumption	Definition
The need to know	Adults require a need to know why they need to learn something.
Learners' self-concept	Adults are self directed and want to choose what, when and how they learn.
The role of learners' experiences	Life experience will positively or negatively influence learning in adults.
Readiness to learn	Adults become ready to learn when they identify a need.
Orientation to learning	Adult learn better in problem based or task based learning: they are life-centred learners as opposed to subject-centred.
Motivation	Adults respond better to intrinsic motivators than extrinsic motivators.

Adults require a need to know why something needs to be learned, by considering the benefits of learning and consequences of not learning. They have a "self concept" in terms of being responsible for identifying what they require to learn and learning should take into account "learners' experiences", which is comparable to the constructivist view on learning. Adults also have to be "ready to learn" and this may be linked to stages of their development as person or in the context of their career. They may become ready to learn if they perceive the benefits of learning, for example improved confidence and competence to help with increased responsibility at work. As such adults respond better to learning that is relevant to a particular task, problem or to life itself. In contrast children may be more receptive

to subject specific learning and thus the "orientation to learning" is another assumption of the andragogical model. Finally "motivation" is key in the andragogical model, and factors that motivate adults differ to those that motivate children. The most effective motivators for adults are intrinsic, such as increased job satisfaction or quality of life, whereas children respond better to extrinsic motivators relating to reward or punishment (Knowles *et al,* 1998).

Inherent in the andragogical views of learning is that learners are self directed and able to reflect on their practice to determine what has been learned and what is required for future success. Schön (1987) describes a continuum of reflective practice ranging from "reflection on practice", where a learner reflects retrospectively on their practice to identify how behaviours can be adapted to improve future practice, to "reflection in practice", where a learner reflects while practising and is able to adapt their behaviours according to new experiences thus thinking on their feet. Both these processes require experience to allow reflection to take place. Kolb's (1984) theory of experiential learning describes a process of learning through four cyclical stages, concrete experience, reflective observation, abstract conceptualisation, and active experimentation. Kolb highlights that learners may have a preference for a particular stage in the learning cycle but learning is more complete when a learner undertakes all stages. Both completion of the learning cycle and reflection in, or on, practice are essential for the life long learning skills required for many professionals.

One concern with undergraduate students is that that may fall somewhere between pedagogical and andragogical categories (Fry *et al*, 2003) as they require underpinning knowledge, which may be obtained conveniently through lectures and guided reading, and that their practical experience may be limited. However, the application of this knowledge in practice will require reflection from their experience if they are to target in gaps in their knowledge individually. Thus

students may have to be facilitated into adopting a self directed approach to learning.

1.3 Instructional design of e-learning

Clark & Mayer (2008) have developed evidence based guidance for instructional design of e-learning programs. Instructional architecture is the technical design and layout of e-learning which influences the level interactivity of the learning and the nature in which knowledge is acquired or constructed. Clark & Mayer (2008) describe three types of architecture which can be related to the three metaphors of learning (Table 1.2).

Table 1.2 Three e-learning architectures (adapted from Clark & Mayer, 2008)

Architecture	Metaphor of learning	Level of Interactivity	Pharmacy example of use
Receptive	Information acquisition	Low	An online lecture to provide students with underpinning knowledge.
Directive	Response Strengthening	Medium	A program simulating the prescription accuracy checking procedure, providing corrective feedback and a score depending on user input.
Guided discovery	Knowledge construction	High	An online collaborative resource helping students develop clinical decision making through synchronous or asynchronous communication.

Each architectural approach has benefits depending on the intended learning objectives. Low interactivity which places the learning in a passive position may be appropriate for providing information to the learner, for example as underpinning knowledge. Examples of such e-learning include online lectures using webinar software which broadcast the lecture over the internet. Interactivity may be increased through the use of polling or question functions in the software but at the basic level this is e-learning with low interactivity. The potential benefits of this

approach are that e-learning resources can be made available at a time that suits the learner and that the resources may be stopped and started to allow self paced learning: which can improve learning outcomes. The directive architectural approach, in which a response strengthening approach is taken, allows learners to test their understanding or level of competence during which they are provided with a positive or negative response from the resource. In its basic form this architecture provides a behaviourist approach to learning. This may be appropriate for learning process or practical skills or for increasing confidence in a learner's knowledge. The guided discovery architecture encourages learners to be "active sense makers" of their learning. This approach follows the constructivist theories of learning and has been the focus of recent instructional design research (Clark & Mayer, 2008).

However, not all e-learning resources or educational approaches fit into a specific architectural model. Moule (2007) developed an e-learning ladder (Figure 1.1) to describe the e-learning approaches in relation to the level of interactivity. The lowest rung on the ladder relates to e-learning that places the learner in a passive position, with little interactivity, increasing to highly interactive e-learning resources that rely on problem solving skills. However, Moule highlights that face to face interactions can be used to supplement e-learning resources, which increase social interaction and moves the educational approach towards constructivist learning. Face to face interactions could be used to supplement any of Clark & Mayer's (2008) architectural approaches.

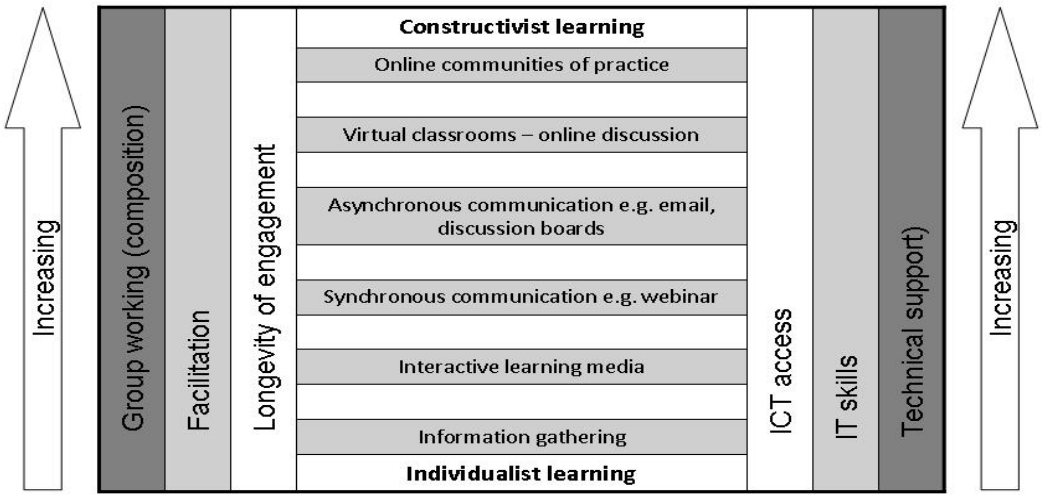

Figure 1.1 e-Learning ladder (adapted from Moule, 2007)

Bernard *et al,* (2009) describe three types of interaction associated with e-learning resources: student – student, student – teacher and student – content. The two types of interaction that have the greatest influence on achievement of learning outcomes are student – student, and student – content. In addition, increasing the presence and the strength of the student – student interactions can improve learner attitudes in e-learning courses. However, the authors comment that "*just because opportunities for interaction or collaboration were offered to students does not mean that students availed themselves of them, or if they did interact or collaborate, that they did so effectively.*" They also state that if "*students are given stronger versus weaker course design features to help them engage in the content, it makes a substantial difference in terms of achievement*". Based on these findings Bernard *et al*, (2009) advise that the prime focus of e-learning design should be to increase student interaction with e-learning content, but additionally increasing interactions between other students and teachers may also improve learning outcome achievements. This is a perspective shared by other researchers in this field (Clark & Mayer, 2008; Bangert, 2004).

To improve the quality of interaction between learners and e-learning content Cook & McDonald (2008) advise that four core tenets of learning (Table 1.3) should be considered during developmental stages of e-learning.

Table 1.3 The four core tenets of learning (Cook & McDonald, 2008)

Core tenet of learning	Description
1st tenet	Integrating new knowledge with previous knowledge and experience
2nd tenet	Problem solving skills should be linked to specific content
3rd tenet	Knowledge should be transferable
4th tenet	Cognitive load can affect the ability to learn

The 1st tenet ties in with the principles of adult learning as it highlights the importance of relating new to existing knowledge, which must therefore take into account different needs for different learners. It is the learner, therefore who must make sense of this new knowledge to integrate into their cognitive schemata.

The 2nd tenet indicates that problem solving skills may be common skills but knowledge and previous experience can influence the application of reasoning skills. Cook & MacDonald, (2008) use diagnosis to emphasise this because the diagnostic strategies adopted by two doctors may be similar but a more experienced doctor may adapt their approach to allow for a quicker diagnosis by relating the information from the current case with previous experiences. With greater experience the formation of paradigms, which relate to internal understanding, is possible.

The 3rd tenet states that knowledge and skills learned in an educational programme should be transferrable to different, real life, settings. Therefore facts learned in a classroom setting should be retrievable during real life practice. In pharmacy

education this could be the assessment of prescriptions for legal and clinical appropriateness. Students may be taught the laws associated with supply of medicines against a prescription, but simulations in a practical class may help increase the likelihood that students can recall this knowledge during community pharmacy practice.

The 4th tenet of cognitive load has been a feature of recent e-learning literature, (Clark & Mayer, 2008; Cook & MacDonald, 2008; Dror *et al*, 2011), which has examined different ways to increase the educational benefit of e-learning instructional design by increasing the quantity of learning that is committed to long term memory. Dror *et al,* (2011) suggest that there are two approaches to achieving this. The quantitative approach, of reducing the amount of information provided, and the qualitative approach which is to "*package the information in a more brain friendly fashion*". The rationale for this is that there are three assumptions of the ways in which humans learn through e-learning. The first is that there are dual channels for learning. Humans can receive information through both visual and verbal channels, which are separate from one another. Thus greater information can be received if both channels are used effectively in a complementary manner. The second assumption is that there is limited capacity of the information that can be processed at any given time. Finally, the process of learning carries a substantial processing (germane) load which limits the quantity of information that can be committed to memory (Mayer & Moreno, 2003).

van Merriënboer & Sweller, (2005), explain that intrinsic load and germane cognitive loads are essential in the act of learning as they provide the relevant information and are an active part of the learning process, respectively. Therefore, reducing these aspects of cognitive load would adversely affect the learning process. Extraneous cognitive load, however, is surplus to requirement and acts as a barrier to effective learning. Reducing extraneous cognitive load would enhance the learning experience (Cook & McDonald, 2008) and would form part of a

quantitative approach to reducing overall load (Dror *et al*, 2011). This may require the removal of the aspects of e-learning that have been added specifically to improve aesthetics. Alternatively a qualitative approach such as "*distorting and manipulating material so that they exaggerate and over emphasise the important information*" can help package material in a low load fashion. This may result in the images being presented in a way that is not entirely true to life and requires expert knowledge on how humans interpret information cognitively so that it can be presented in the most efficient manner (Dror *et al*, 2011).

Clark & Mayer (2008) have conducted numerous experiments to determine the most effective way of delivering education through technology and have devised a series of principles, originally for multimedia learning which have been adapted to e-learning and aim to guide educators in designing efficient e-learning programs. The principles of good instructional design provide a good practice guide to increase the effectiveness of e-learning (Table 1.4), often by reducing extraneous cognitive load.

Table 1.4 Principles of e-learning instructional design (Clark & Mayer 2008)

Principle	Description
Multimedia	Both words and pictures used Reduces cognitive load and increases information quantity
Contiguity	Related information, words and images, should be placed in proximity to one another because this reduces extraneous load.
Modality	Spoken word should be used to explain graphics rather than text, because this reduces cognitive load.
Redundancy	Explain images with words in either audio or text, but not both because this can overload the visual channel.
Coherence	Avoid using images, words, or audio that does not add to the learning. Removes distractions and reduces cognitive load.
Personalisation	Use a conversational tone in wording of e-learning Lowers extraneous load.
Segmenting and Pretraining	To aid the learning of complex material, break the key concepts and interactions into segments Provide pretraining to increase the learners' familiarity with the names and characteristics in these concepts.
Worked example	Use worked examples to reduce cognitive load. Novice learners may require more support that expert learners.
Practice	Mirror the job, provide explanatory corrective feedback, base practice requirements on performance requirements. Apply multimedia principles to practice questions Use fading to move from examples to practice.
Learner control	Adjust learner to control (pacing, sequencing and access to support) in relation to stage of development. Important instructional events should be default Consider adaptive control – the program adapts content based on user responses.
Thinking skills	Use job-specific cases, worked examples and feedback linked to model answers
Simulations and games	Ensure program is aligned to the intended learning outcomes. Follow the logic of the multimedia principles Encourage reflection on performance.

The four core tenets of learning and the instructional design principles have been developed from evidence of e-learning from various contexts. Within health professional education a large systematic review and meta-analysis has demonstrated that incorporating interactivity, practice exercises, repetition and

feedback, can result in improved learning outcomes, and that online discussion and audio was linked to increased user satisfaction (Cook *et al,* 2010). Cook *et* al, (2010) advise that more research is required in this area, but that of the research conducted by Clark & Mayer (2008) can guide e-learning development within healthcare, despite their research being conducted out with this context.

1.4 Integrating e-learning into curricula

The choice of using technology over traditional and often pre-existing methods of educational delivery is not a simple decision. Not only must the most appropriate format of e-learning be chosen to meet specific learning outcomes but the extent to which existing material is to be replaced by e-learning must be considered. There are also options to make e-learning synchronous or asynchronous in nature, both of which have advantages and disadvantages. With synchronous e-learning the learner communicates with the teacher and / or their peers in real time and may follow a structured approach to learning. Synchronous e-learning has many similarities and challenges to traditional learning except that it can be delivered at distance. In contrast asynchronous e-learning has a time delay between communications but these programs can be accessed when and where the learner requires (Clark & Mayer, 2008). Asynchronous e-learning relies on good motivation and a self efficient learning style.

University courses may be entirely online, entirely face to face (traditional), or a mix of the two as a blended or hybrid learning (Tallent-Runnels *et al*, 2006). A recent definition of blended learning is *"the organic integration of throughtfully selected and complementary face-to-face and online approaches and technologies"* (Garrison & Vaughan, 2012). This definition highlights the intention to obtain the benefits of both traditional and online approaches to enhance educational courses, an approach which may offer greater benefit to either a traditional or an online approach alone. More research is required to support this statement (Bernard *et al*, 2009).

Twigg (2003) describes a nationally funded programme in the United States where thirty colleges and universities evaluated and redesigned one of their existing courses, incorporating the use of e-learning. The six common aspects of each redesign project were: entire course evaluation; greater learner-centred and interactive learning; greater use of technology; greater flexibility for student engagement; increased support on-demand; and staffing redesign. Given the diverse nature of the courses being redesigned, each of these aspects was implemented in different ways and to varying extents. However, Twigg (2003) noted five distinct models of course redesign relating to the extent to which technology was used in the redesigned course (Table 1.5). Twigg (2003) reports that well implemented e-learning can have similar effectiveness to traditional educational methods in terms of learning outcomes with increased student satisfaction and attitude leading to better completion and retention rates.

Table 1.5 Course redesign models (Twigg, 2003)

Course redesign model	Key features
Supplemental model	Retained basic course structure. Technology is added to increase revision opportunities and student engagement.
Replacement model	Replace some in-class activities with online, interactive learning activities, aligned with remaining in-class activities.
Emporium model	Students choose the topics, material and learning methods to suit their learning needs. Students additionally receive guidance from online instructional software.
Fully online model	Courses presented entirely by online software. This increasing student numbers, flexibility and can allow immediate feedback on submission of assignments.
Buffet model	Variety of learning opportunities (online, face to face, individual and group), allowing students to pick and choose the best learning activity or resource to their learning needs and style.

1.5 Evaluation of e-learning

Any educational programme requires evaluation to determine its merits and development opportunities. In preparation for development and evaluation all stakeholders, including the university department, the teachers and the students, should be consulted to ensure there is a clear meaning or intention (Cook, 2010b). Evaluation outcomes are often referenced in relations to Kirkpatrick's (1994) fours levels of evaluation, which are, reaction, learning, behaviour, and results. The first level of evaluation is Reaction (level 1) which focuses on participant feedback and perceptions. A positive reaction is required for a successful education programme, with learning less likely if participants have a negative reaction to the programme. Learning evaluations (level 2) aim to determine if a programme has brought about a change in attitude, an increase in knowledge, or an improvement in skill. Behaviour evaluations (level 3), are conducted to identify if learning has resulting in a change in behaviour. The final level, Results (level 4), determines the actual result of the implementation of an educational programme through achievement of tangible results such as increased improved pass rates. This level can be difficult to achieve particularly if the educational programme is targeted at skills that relate to non-tangible behaviours such motivation or leadership.

Although levels 3 and 4 can provide valuable information, changes in learner behaviour will only occur if all four conditions are met. There must be a desire to change, knowledge of how to change, a climate that supports change and reward for the change. As such, a programme may be successful in creating a positive reaction (level 1) and results in learning (level 2), but a change in behaviour (level 3) may not be present. This does not necessarily indicate failure of the programme but may adversely affect the conclusion of a behaviour or results evaluation if conducted in isolation. As such Kirkpatrick advises the importance of including level 1 and 2 evaluations (Kirkpatrick, 1994).

Another consideration is the perspective or orientation of the evaluation. This may be objectives, process or participant oriented (Cook, 2010b). An objectives-oriented evaluation requires specific instructional objectives to be set at the start of the programme and the evaluation is a measurement of achievement of these objectives. This approach may be straight forward to implement but due to inflexible objectives this approach might not be suited to evaluating a developing programme. Two other concerns are that poorly chosen objectives may lead to trivial or unrealistic outcomes and there is a risk that educators will focus on achieving objectives rather than focussing on learning. That is, helping learners pass a test rather than helping them to learn.

A process-oriented evaluation is more suited to programme development. This form of evaluation is implemented from the outset, determining the need of a programme, focussing on how to meet this need, then developing the programme and re-evaluating as an ongoing process. Although time consuming and sometimes not conducted in full due to the adaptive nature of the process, this type of evaluation can provide detail on each stage of development. An objectives-oriented evaluation may be implemented to conclude the evaluation process.

A participant-oriented evaluation focuses on the interpretation of the perceptions of the learners who utilised the educational programme. It is often completed in a cyclical, ongoing basis. Due to the humanistic nature of this type of evaluation, qualitative rather than quantitative methods tend to be required with triangulation to ensure a broad perspective is obtained. Although the use of this type of evaluation is increasing, the findings can be subjective and may not be generalisable to other programmes (Cook, 2010b).

Cook (2010b) advises that before conducting an evaluation the desired outcomes should be identified before choosing a method of analysis, then a specific instrument to conduct this analysis is identified, and finally the modality by which

this instrument is used is considered. For example, in the context of a pharmacy practice dispensing class, the knowledge and understanding component of this class may be assessed by examination, which may take place using a number of instruments, such as multiple choice questions or essay examinations. Finally, the modality of assessment may be conducted as a paper based exercise in a traditional setting or online. The reason for defining the outcome first is that if the evaluator favours a particular instrument they may measure the wrong outcome. Again with reference to a pharmacy practice dispensing class example, a written exam would not assess the behaviour or skill based outcomes associated with pharmacy practice.

In terms of evaluating e-learning in Healthcare professionals the most common measures tend to fall into Reaction or Learning. In a review of 31 studies of web-based learning for health professionals Chumley-Jones *et al*, (2002) reported that the majority of studies focussed on learner satisfaction or knowledge gains and only two studies assessed learner efficiency and one study reported an evaluation of costs. Similarly in two systematic reviews with meta-analysis, Cook *et al*, (2008) reported that from 130 studies comparing e-learning to no intervention and 76 studies comparing e-learning to traditional education, only 27% and 24% of the studies included a level 3 or level 4 evaluation, respectively. However, the authors comment that small sample sizes, low methodological quality and inconsistencies between studies limit the interpretation of their results.

1.6 The General Pharmaceutical Council and the MPharm Degree

1.6.1 The General Pharmaceutical Council Standards for the Initial Education and Training for Pharmacists

Since September 2010 registration as a Pharmacist in the Great Britain has been regulated by the General Pharmaceutical Council (GPhC). Before this date regulation was one of the roles of the Royal Pharmaceutical Society of Great Britain (RPSGB) which split into the regulator, the GPhC, and the professional body, The Royal Pharmaceutical Society (RPS). The GPhC and previously the RPSGB have established standards for the Initial Education and Training for Pharmacists (GPhC, 2011a) which list the standards that must be achieved through completion of a GPhC accredited university course and pre-registration training. The standards include the outcomes expected of pharmacy professionals upon completion of an undergraduate degree and pre-registration training. In November 2012 there were 25 universities in the UK with fully accredited MPharm programmes with three additional Universities working towards accreditation (GPhC, 2012c).

Initial education and training outcomes

The standards for the Initial Education and Training contain educational outcomes that all pharmacy students must be able to demonstrate by graduation. There is an additional set of outcomes that must be achieved during a year of pre-registration training, but these are only applicable for Universities who provide a five year integrated degree that incorporates pre-registration training into the undergraduate degree. In November 2012 there were no universities actively delivering this form of the degree although Bradford University offers a sandwich course which results in graduation and registration at the same time.

The outcomes are presented in relation to Miller's Pyramid (Miller, 1990). This is widely used in healthcare education to guide assessments because it differentiates between having underpinning knowledge (knows), the competence to use that

knowledge (knows how), the ability to demonstration of performance (shows how) and performance, or action, of an individual in daily practice (does) (Figure 1.2).

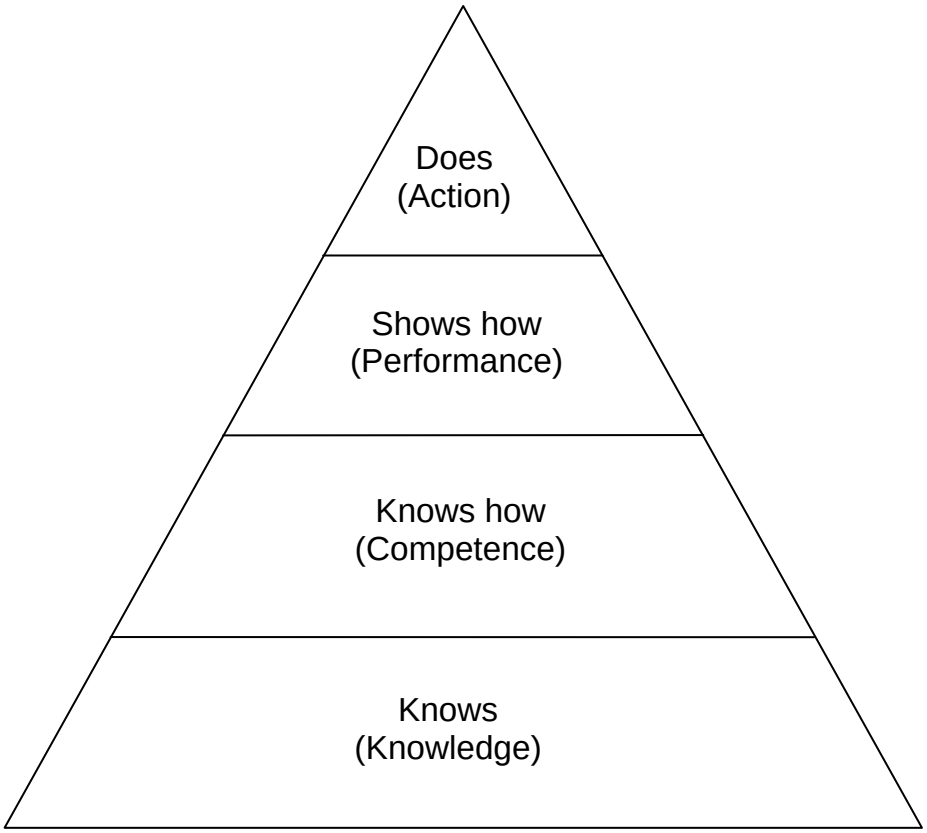

Figure 1.2 Miller's Pyramid: framework for clinical assessment (Miller, 1990)

The outcomes that require achievement of the Shows how (performance) or Does (action) levels of Miller's Pyramid are more challenging to assess (Miller, 1990) than the lower levels. During undergraduate education a pharmacy student may be able to "show how" during observation of their performance through simulations or objective structured clinical examinations (OSCE), whereas workplace based assessments may be required for demonstration of the "does" outcomes (Norcini, 2003). As such, Universities may make use of competency based role play assessments or OSCEs.

1.6.2 University of Strathclyde MPharm

The University of Strathclyde is one of 25 accredited Schools of Pharmacy in the UK. The majority of the MPharm students are from a Home cohort who undertake the 4 year course as full time students at the University of Strathclyde. Each academic year comprises two semesters of 15 weeks: semester 1 from September to January and semester 2 from February to June. After graduation these students can undertake a pre-registration placement which ultimately leads to registration with the GPhC as a pharmacist if all the assessments are passed.

Since the 2007 – 2008 academic year, the University of Strathclyde introduced a 2+2 model of the degree in which students were able to start their degree by completing the equivalent of two academic years (four semesters) at the International Medical University (IMU), Kuala Lumpar, Malaysia before attending the University of Strathclyde for the final two years (four semesters). In September 2009, the first cohort of 2+2 students commenced the third year of their degree at the University of Strathclyde, as part of the Home cohort. Due to the completion of two years of study in the UK these students are eligible for a pre-registration placement and subsequent registration with the GPhC as a pharmacist.

The Collaborative cohort, part of an agreement with the IMU since 1996, are students who undertake the same degree course as the Home cohort, but they complete five of the eight semesters at the International Medical University, Kuala Lumpur, Malaysia, before completing the remainder of the degree at the University of Strathclyde. These students are required to complete a competency class and two specialist laboratory based classes at the University of Strathclyde in the summer before entering 4th year: they undertake a compressed summer teaching programme immediately before completing the final two semesters alongside the Home Cohort.

Table 1.6 Home, Home 2+2 and Collaborative timetables

Year	Month											
	O	N	D	J	F	M	A	M	J	J	A	S
Year 1 (Home)	Semester 1				Semester 2							
Year 1 (Collaborative)				Semester 1					Semester 2			
Year 1 (Home 2 +2)				Semester 1					Semester 2			
Year 2 (Home)	Semester 3				Semester 4							
Year 2 (Collaborative)	Semester 3							Semester 4				
Year 2 (Home 2 +2)	Semester 3							Semester 4				
Year 3 (Home)	Semester 5				Semester 6							
Year 3 (Collaborative)	Semester 5								Semester 6 (Summer semester)			
Year 3 (Home 2 + 2)	Semester 5				Semester 6							
Year 4 (all students)	Semester 7				Semester 8							

The material studied by all students is common and the degree is awarded by the University of Strathclyde so the same standards are expected of all cohorts.

1.6.3 The competency based class

A number of the outcomes that require achievement of "shows how" by the undergraduates are assessed through the competency based class delivered in the third year of the MPharm at the University of Strathclyde (Table 1.7). The Home and 2+2 students are taught this class over two semesters in the third year of their degree. The Collaborative cohort are taught this class as part of the compressed summer semester, at the University of Strathclyde, immediately before entering the final year of the degree (Table 1.8).

Table 1.7 GPhC outcomes assessed at level "shows how" in the competency based class (GPhC, 2011a)

GPhC outcome	Outcome descriptor
10.2.2.c	Instruct patients in safe and effective use of their medicine
10.2.2.d	Analyse prescriptions for validity and clarity
10.2.2.e	Clinically evaluate the appropriateness of prescribed medicines
10.2.2.f	Provide, monitor and modify prescribed treatment to maximise outcomes
10.2.2.g	Communicate with patients about their prescribed treatment
10.2.2.h	Optimise treatment for individual patient needs in collaboration with the prescriber.
10.2.2.j	Supply medicines safely and efficiently consistently within legal requirements and best professional practice. NB this should be demonstrated in relation to both human and veterinary medicines
10.2.4a	Establish and maintain patient relationship while identifying patients' desired health outcomes and priorities
10.2.4b	Obtain and record relevant patient medical, social and family history
10.2.4d	Communicate information about available options in a way which promotes understanding
10.2.4e	Support the patient in choosing an option by listening and responding to their concerns and respecting their decisions
10.2.4f	Conclude consultation to ensure a satisfactory outcome
10.2.4h	Provide accurate written or oral information appropriate to the needs of patients , the public and other healthcare professionals

Table 1.8 Competency class in relation to academic year

<table>
<tr><td></td><td colspan="12">Month</td></tr>
<tr><td>Subgroup</td><td>O</td><td>N</td><td>D</td><td>J</td><td>F</td><td>M</td><td>A</td><td>M</td><td>J</td><td>J</td><td>A</td><td>S</td></tr>
<tr><td>Home and Home 2+2</td><td colspan="3">Practical labs

All directly related to SCRIPT</td><td>Exams</td><td colspan="3">Practical labs

1 of 12 directly related to SCRIPT</td><td>Exams</td><td colspan="4">Break</td></tr>
<tr><td>Collaborative</td><td colspan="4"></td><td colspan="3"></td><td colspan="3">Practical labs*

13 / 24 directly related to SCRIPT</td><td>Break</td></tr>
</table>

*final assessment for the collaborative cohort is at the end of August

The competency based class is taught in a laboratory setting which mimics a real life pharmacy dispensary. During this class students must participate in the simulated exercises where they must use the underpinning knowledge gained from other parts of the degree, to assess prescriptions for clinical and legal appropriateness, then label, dispense and check these prescriptions. The students may need to liaise with staff, who role-play as prescribers, patients or patient representatives, to obtain all the information that they require to complete the prescription assessment. Students must issue the completed prescription to a role-play patient or patient representative. When speaking to the patient the student is expected to counsel appropriately on the prescribed medication, which may involve provision of supplementary information such as lifestyle or health promotion advice. Staff who are involved in teaching the class are registered pharmacists and they assess students' performance during the role-play before providing feedback and advice.

The competency based class has four assessments, one of which is formative and three of which are summative (Table 1.9). During each assessment, students begin

with 100% and have marks deducted for each error made. The marks deducted equate to the severity of the error (Appendix 1.1). The class has a pass mark of 50%, but the class is reported to the students as either a pass or fail. The third assessment is an exemption assessment. Students can gain exemption from the final degree assessment if they achieve 70% in this assessment.

Table 1.9 Assessments in the competency based class

Assessment	Contribution to class	Time of assessment
Class assessment 1	Formative	After 10 laboratory sessions
Class assessment 2	10% of class mark	After 20 laboratory sessions
Exemption assessment	90% of class mark (Pass/fail - 70% required for exemption)	Two weeks before the Degree assessment
Degree assessment	90% of class mark (only for students who fail exemption assessment)	After all taught elements of the class

During the assessments students are assessed on knowledge and understanding, problem solving skills and interpersonal skills. Students must develop a self-directed and reflective approach to determine which skills they need to develop personally. Due to the range of skills required for this class each student may start at a different level based on their previous experience. Many students seek part time employment in community pharmacies to facilitate their learning which highlights the application of their learning and indicates motivation to learn as adults (Knowles *et al*, 1998). This sense of ownership of their learning is essential because it forms the basis of continuing professional development (Fraser *et al*, 2007) which is a regulatory requirement for all fully qualified pharmacists (GPhC, 2010).

1.7 Strathclyde Computerised Randomised Interactive Prescription Tutor (SCRIPT)

In 2004 staff from the School of Pharmacy at the University of Strathclyde obtained funding from the Scottish Funding Council as part of the Reengineering of Assessment Practice (REAP) project. Part of this funding was used to develop an e-learning resource to support students who were undertaking the competency based class. A student feedback had indicated that the impression was that the competency based class was more difficult to pass than other classes, because of its practical nature and because there were limited revision opportunities outwith class teaching. Students indicated a desire for a revision aid for class (Fullerton *et al,* 2006).

In 2005, Strathclyde Computerised Randomised Interactive Prescription Tutor (SCRIPT), an e-learning simulation tool, was created to address this need. A group of final year project students were provided with a basic template of SCRIPT and were asked to contribute to its development. The plan was to create a program which simulated the problem solving element of the competency based class, offering a greater opportunity for students to assess their own competence. The students recognised the requirement to create scenarios which simulated the class teaching, in both content and complexity. They consulted the class co-ordinator and reviewed the class notes to ensure similarity to any samples they created, being careful to avoid duplication of material. The students also asked practising pharmacists for examples of real scenarios that could be incorporated into the program.

Scanned mock up prescriptions, similar to those in the class notes, were used in SCRIPT version 1 (Figure 1.3). For each scenario, students were presented with background information about the patient for whom the prescription had been issued to help determine clinical appropriateness of the prescribed medicine. There were also areas for error selection and to indicate the registration requirements for the scenario. Students could then assess their performance by clicking the mark button at the bottom right of the screen.

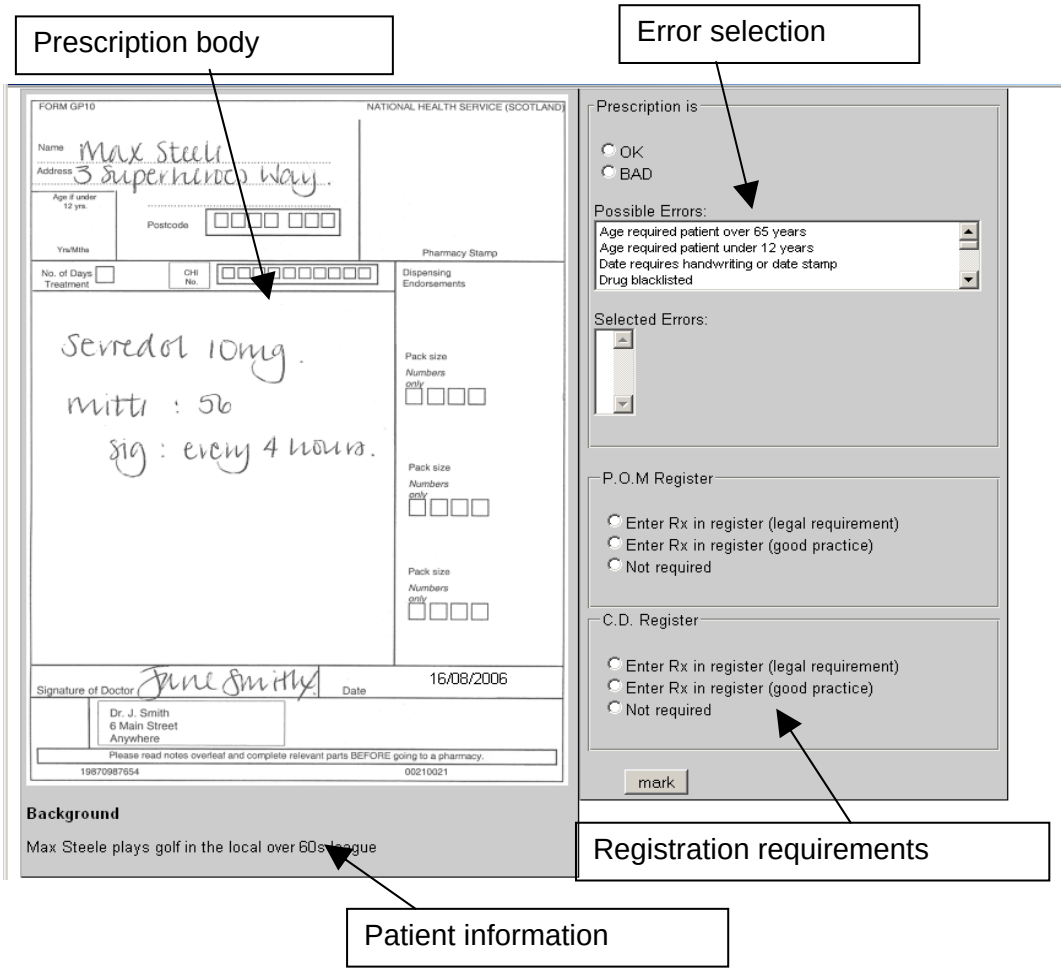

Figure 1.3 Prescription scenario from SCRIPT version 1.

When responses were submitted students were directed instantly to a feedback screen (Figure 1.4). The feedback screen contained the original prescription for reference, corrective feedback with standardised wording to describe why responses were correct and incorrect. Students were also provided a mark based on the marking scheme from the competency based assessment.

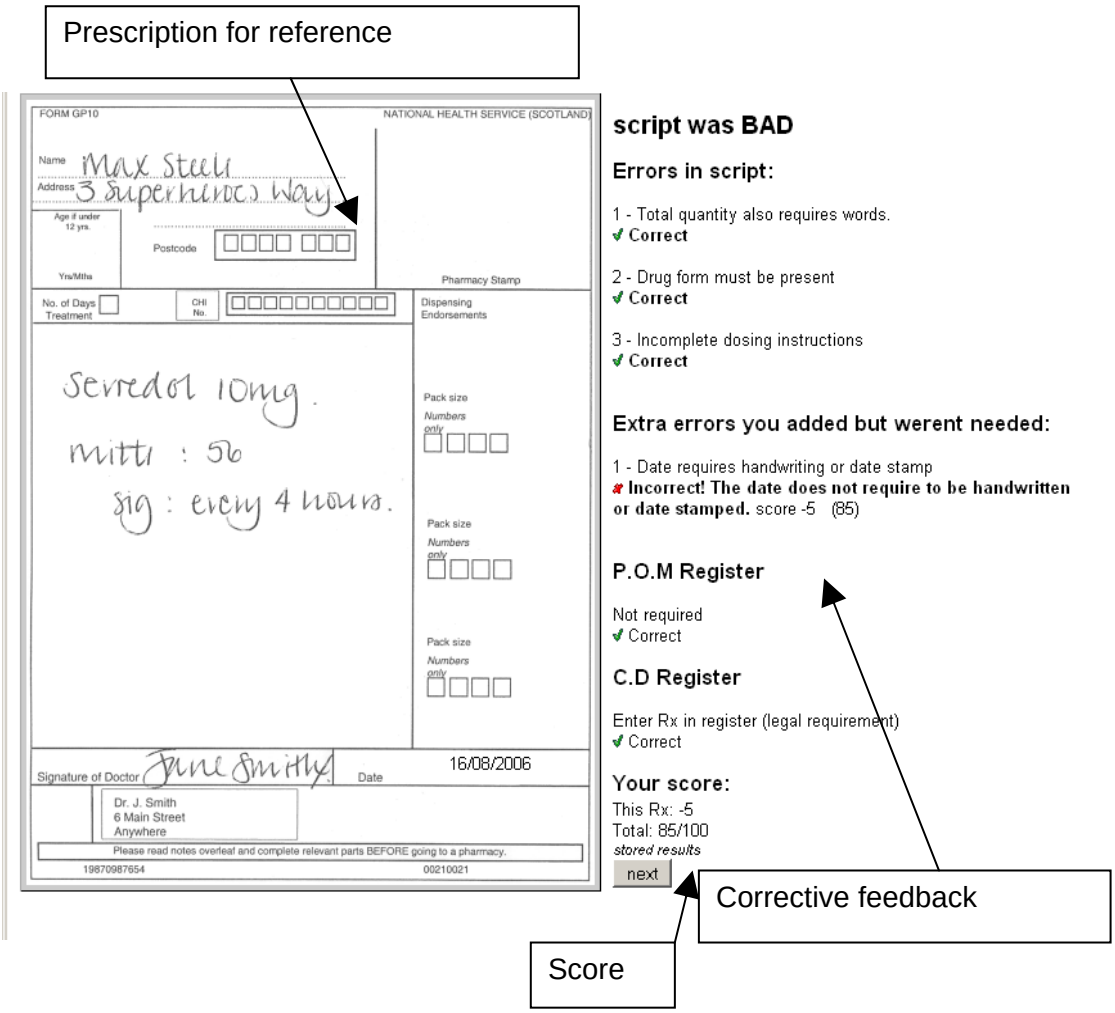

Figure 1.4 Feedback screen from SCRIPT version 1.

The original pilot of SCRIPT (version 1) contained nine handwritten prescriptions which looked identical to the format of the examples in the class. These included examples of NHS prescriptions, controlled drug prescriptions and dental and nurse prescriptions. The majority of the examples contained errors but there were correct examples included. Prescriptions were grouped into tests of three scenarios chosen randomly from the bank of nine.

In Version 2 the format of the prescriptions was changed so that the prescription details were computer generated onto a scanned background of an NHS prescription (Figure 1.5). This allowed the name and address of the patient and the prescriber to be varied thus creating the illusion of a greater number of

prescriptions. This also improved the aesthetics of the program and helped highlight the differences in prescription types which are coloured in real practice. At this time the number of scenarios was expanded to approximately 180 with many of the examples created by practicing pharmacists.

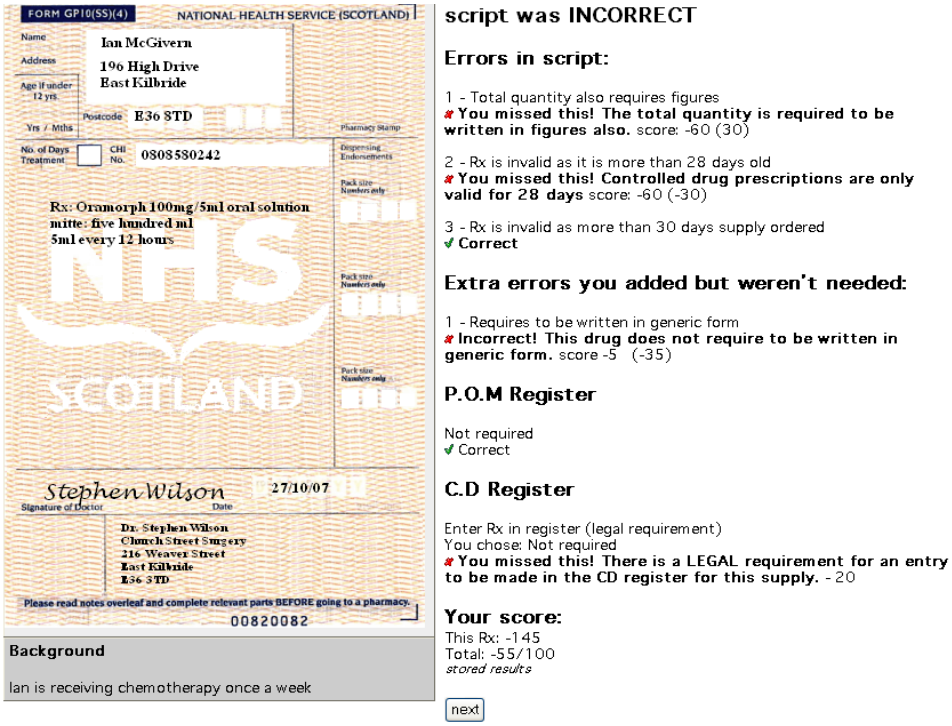

Figure 1.5 Prescription feedback from SCRIPT version 2.

In both versions the students would assess each prescription in turn and select any errors that they would amend if an assessment or in real life practice (Appendix 1.2). They would then be given a score calculated from a marking scheme that reflects that used in the competency based class assessments; each test was allocated 100 marks with deductions made for every error missed. Although not intended as an assessment tool, the students who gave feedback thought that marking was relevant for their understanding of where they might lose marks in the class assessments. The program was piloted on academic staff and then final year students.

The class of 2006 – 2007 had access to all prescriptions in version 2 before the exemption and degree assessments and provided feedback through an online questionnaire.

To prepare SCRIPT for use in the PhD study, the basic feedback provided for each scenario was reviewed to increase standardisation between scenarios. In addition emergency supply and veterinary scenarios were added by using templates provided by practising pharmacists. SCRIPT was amended (version 3) to add information tabs, allowing users to control the information that was displayed on screen by clicking on the relevant tab to switch between views (Figure 1.6).

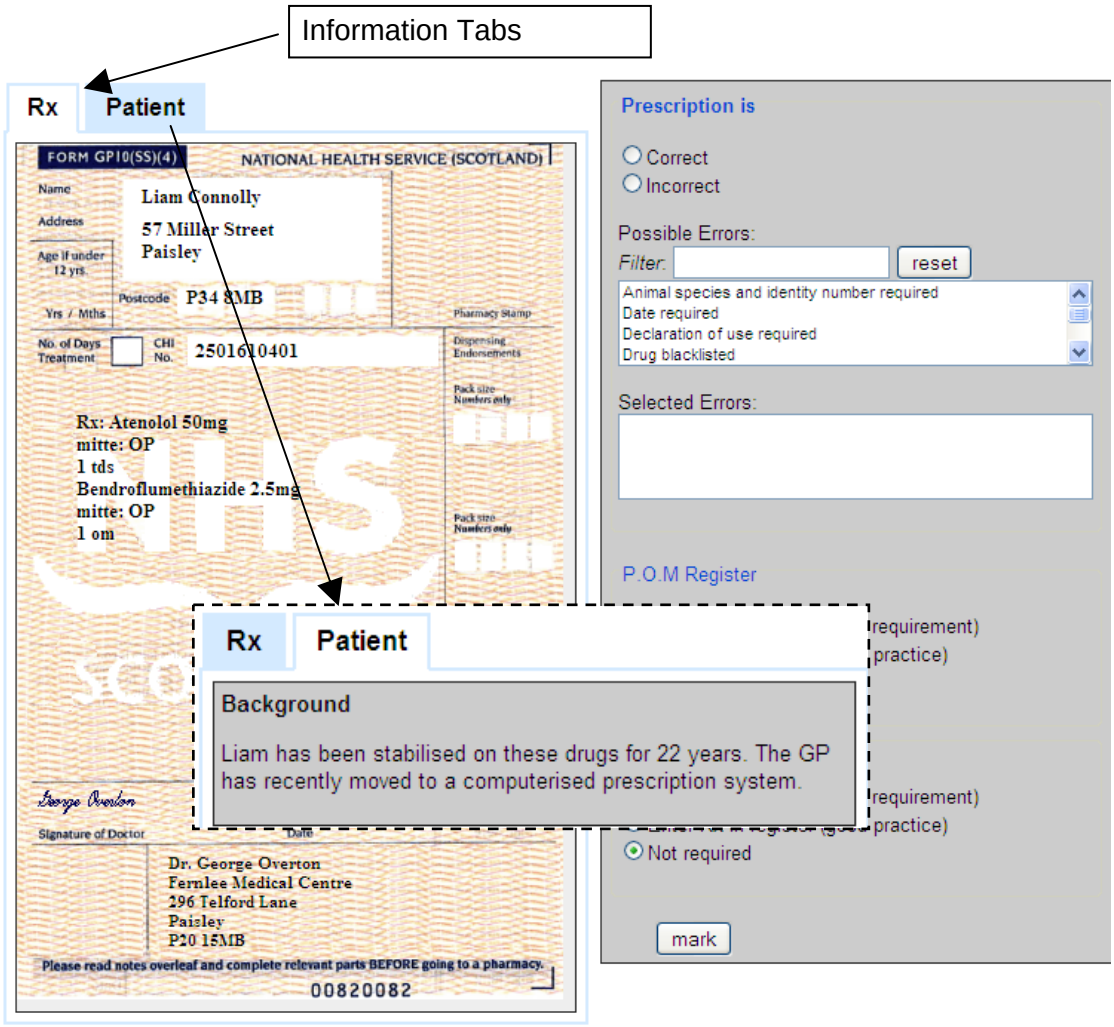

Figure 1.6 SCRIPT with information tabs

Until 2007 – 2008 SCRIPT was evaluated through online questionnaires which were analysed by undergraduate project students and then by the program development team. These analyses helped inform the development of SCRIPT, but no analysis of student use had been conducted to determine the number and nature of student logs. One advantage of e-learning compared to traditional teaching methods is that individual user access can be monitored to evaluate quantitatively how students use the technology, in addition to qualitative methods. User access data can be used to describe the behaviour of e-learning users (Shih *et al.* 2008). SCRIPT automatically creates a record of all access (Table 1.10).

Table 1.10 Data automatically recorded by SCRIPT

Title	Description
ID	A chronological number relating to the attempt of a SCRIPT triplet of scenarios.
Username	The unique identifier of the individual accessing SCRIPT (student number) which was anonymised.
Test ID	The unique identifier of the test selected.
Results	The results achieved from the triplet of scenarios attempted, containing the final score for each scenario and details of each error made.
Score	The cumulative score of the three scenarios in the triplet.
Date and time	The date and time that the triplet of scenarios was first accessed.
Session	The academic year in which the access was made (from October to September).
Completed	1 or 0 to indicate if the user completed all three scenarios.

This thesis will focus on the evaluation and development of SCRIPT from the 2007 - 2008 academic year making use of both quantitative and qualitative research methods.

Comparison of SCRIPT with evidence for e-learning programs.

Theoretically, the place of SCRIPT as a revision tool for the competency based class should meet each of the core tenets of learning (Cook & MacDonald, 2008) because students have opportunity to test their application of newly learned knowledge thus meeting the first and second tenets. The third tenet is achieved through the simulated nature of SCRIPT, which supports students to construct their own understanding of what is a legal and clinically appropriate prescription. Students are encouraged to develop their individual processes for assessing future prescriptions, which makes this learning transferrable. Finally, in relation to the forth tenet, cognitive load is primarily managed through the self paced nature of SCRIPT. In addition a number of the e-learning principles were met, for example, the Coherence principle was achieved by ensuring that all images and wording were relevant to the learning process and not just to enhance aesthetics of the program. The Contiguity principle was achieved by the incorporation of the prescription image, the students' responses and the correct responses with an explanation, all on the one feedback screen. This allows students to interrogate their answers without the need to change screens which would add cognitive load. A number of principles were partly achieved and could be reviewed to enhance future version of SCRIPT: these include the Practice, Learner control, Thinking skills, and Simulation and Games principles. The Personalisation, Segmenting and Pretraining, Worked example principles were not achieved in the early versions of SCRIPT and should also be considered during program enhancements. Finally the Multimedia, Modality, and Redundancy principles were not directly applicable to SCRIPT because it is a simulation and does not contain any audio: however they too should be considered in case they become relevant with future enhancements (Clark & Mayer, 2008).

1.8 Aim of the thesis

The aim of this thesis was to develop and evaluate SCRIPT to support undergraduate and pre-registration pharmacy education and training. The use of SCRIPT was evaluated annually and an iterative process was used to change and further develop SCRIPT thus the aims developed through the thesis.

Chapter 2

Evaluation of student use and perceptions of Strathclyde Customised Randomised Interactive Prescription Tutor (SCRIPT) Version 3.0

2 Evaluation of student use and perceptions of Strathclyde Customised Randomised Interactive Prescription Tutor (SCRIPT) Version 3.0

2.1 Introduction

SCRIPT was developed by Dr Anne Boyter, Senior Lecturer, and Mr Ian Thompson, Computer Officer, in the Strathclyde Institute of Pharmacy and Biomedical Sciences (SIPBS) at the University of Strathclyde and piloted between 2005 and 2007 on students studying the Master of Pharmacy (MPharm) course. It was designed to provide MPharm students with support for revision in a competency based pharmacy practice class. Students had identified the competency based class as a source of concern due to the practical nature of the assessment and the perceived difficulty in preparing for this assessment. In the assessment students are asked to clinically and legally check prescriptions and to dispense these before providing the final product to a simulated patient in a role play situation. Students have to liaise with and counsel staff who play the role of prescribers and patients throughout the assessment. Students begin the assessment with 100% and have marks deducted for each error made during the assessment. The marks deducted equate to the severity of the error, either clinically or legally. SCRIPT was developed to provide an optional study aid that could be accessed at a time and place convenient to the students, helping them to prepare for the class assessment. It was designed to replicate the types of problems students could face in the assessment, allowing them to test their knowledge, understanding and problem solving skills. The marking scheme for the assessment is also used in SCRIPT and allows students to gauge their performance in SCRIPT in relation to the class assessment.

In the 2005 – 2006 and 2006 – 2007 academic years SCRIPT was piloted with a limited number of tests and was evaluated through an online questionnaire hosted on the University of Strathclyde VLE, Strathclyde Personal Interactive Developmental Educational Resource (SPIDER). Final year students who had

completed the competency based class piloted and evaluated SCRIPT. There was no investigation of student access patterns during the initial development of the tool.

During academic year 2007 – 2008, SCRIPT was made available to all students undertaking the competency based class and was advertised as a key resource for revision. Two hundred scenarios which were representative of the questions that students would face during the class and class assessments were included in the tests. These were not aligned to the teaching material in terms of date of release, and the program was not used as a teaching tool during the class.

2.2 Aim and objectives

The aim of this study was to evaluate student use and perceptions of the SCRIPT program during the academic year 2007 – 2008 where the program was used as a revision aid for the competency based class.

The objectives of this study were to

- determine the pattern of use of SCRIPT, in terms of access by students from Home and Collaborative cohorts,
- describe the pattern of use in the seven days before and after each class assessment
- determine the correlation between SCRIPT use and academic achievement in the class and the credit weighted average (CWA) for all classes in the year
- evaluate student and staff perceptions of the program, and
- make recommendations for the further development of SCRIPT.

2.3 Methods

2.3.1 Inclusion and exclusion criteria

All students from both the Home and Collaborative cohorts who were enrolled in the competency based class, including those who were re-attending, were permitted voluntary, remote access to SCRIPT. Students not enrolled on the competency based class and fourth year students who were resitting the class were excluded from the study.

Staff, in SIPBS, who taught on the competency based class were included in the staff perceptions study, and staff who did not teach this class were excluded. The SCRIPT design and editorial team were excluded from the study. No staff access to SCRIPT was included in this study.

2.3.2 Setting

SCRIPT was made available to the students included in the study through the University of Strathclyde VLE, SPIDER. SPIDER was available 24 hours a day during the teaching and revision period. SCRIPT was made available, through specific class codes, from the 2nd of November 2007 for the Home cohort and from the 25th of June 2008 for the Collaborative cohort. All students had access to SCRIPT until the 9th of September 2008.

All students received the same introductory lecture and demonstration delivered by the SCRIPT editorial team in a lecture theatre setting. The students were advised that SCRIPT was a revision aid to help them prepare for the class assessments and they were reminded, by messages on SPIDER, before each assessment. Staff teaching on the competency based class were permitted the same access as students to SCRIPT to allow them to become familiar with the program, but did not receive formal training.

SCRIPT was not used during the practical classes, nor was it aligned to teaching in terms of class topics. Student use of the program was entirely in their own time outwith any timetabled teaching.

2.3.3 SCRIPT content

The version of SCRIPT available to both cohorts contained 200 scenarios covering the most common prescription types: GP prescriptions, including NHS, private, controlled drugs and paediatrics; nurse prescriptions; and dental prescriptions. SCRIPT was available as four tests (NHS prescriptions (n = 127), controlled drugs (n = 14), a combined test of paediatrics (n = 10), dental and nurse prescriptions (n = 40), and a revision test containing all examples, including 9 private prescriptions scenarios. On accessing each test students were presented with a randomly selected triplet of scenarios.

2.3.4 Data collection and refinement

SPIDER automatically recorded every access to a triplet of scenarios (Table 2.1). The data were exported to Excel for analysis eight days after the final degree assessment.

Table 2.1 Data automatically recorded by SCRIPT

Title	Description
ID	A chronological number relating to the attempt of a SCRIPT triplet of scenarios.
Username	The unique identifier of the individual accessing SCRIPT (student number) which was anonymised.
Test ID	The unique identifier of the test selected.
Results	The results achieved from the triplet of scenarios attempted, containing the final score for each scenario and details of each error made.
Score	The cumulative score of the three scenarios in the triplet.
Date and time	The date and time that the triplet of scenarios was first accessed.
Session	The academic year in which the access was made (from October to September).
Completed	1 or 0 to indicate if the user completed all three scenarios.

The data were analysed according to the inclusion/exclusion criteria, removing any records relating to excluded students and all staff attempts. Any entries relating to access before or after the study period were also removed. Entries relating to a scenario which was opened but not attempted, containing no information in the answers column, were removed from the analysis; however, partially completed entries were included.

2.3.5 Pattern of use of SCRIPT, in terms of access by students from Home and Collaborative cohorts

The data were organised to facilitate analysis of access according to time of day and date, for each cohort. Data were interrogated to determine of the total number of SCRIPT attempts made for each student and cohort. Data were sorted according to the time of day, in hour blocks, at which an attempt was made. The number of attempts made in each hour was counted for the each cohort. A rolling average was applied, taking the average of three points, to display the access trends over the day taking account of fluctuations at individual time points. Data were sorted according to the day of the week, and the academic week running from Monday to Sunday, on

which an attempt at SCRIPT was made. The number of attempts made on each day was counted for each cohort. The pattern of access seven days before and after each class assessment was determined by counting the number of attempts made by each student and cohort on all dates for seven days before and after each class assessment (class assessment 1, class assessment 2, exemption assessment and degree assessment). All access was corrected to use per 100 students to account for differences in cohort size.

2.3.6 Correlation between SCRIPT use and academic achievement in the class and Credit Weight Average (CWA)

For each assessment period each student was categorised as a user or non user of SCRIPT. A user was defined as a student who had made at least one attempt at SCRIPT during the assessment period. Information on individual student performance in each of the four class assessments, including the overall mark for each assessment and whether the student passed or failed each assessment, was collated and anonymised by the technical staff associated with the competency based class. These data were then matched with the SCRIPT access data.

SCRIPT access before and after each class assessment was compared to the pass rate of each assessment to determine if access could be correlated with the student's performance in each assessment (Chi square). Since students were awarded a pass or fail for each assessment, this was used as the standard indicator of class performance rather than the raw mark. The student's credit weighted average (CWA) for 3rd year classes was used as a marker of their academic ability and this was compared with the number of SCRIPT attempts made by the student. The CWA was based on the student's performance in all 3rd year classes except the competency based class. Student performance in an individual class is weighted according to the number of credits for that class. The competency based class is excluded from the CWA because it is reported as either pass or fail.

2.3.7 Evaluation of student and staff perceptions of SCRIPT

Student perceptions of SCRIPT were determined through completion of an online questionnaire. The questionnaire was designed by the SCRIPT editorial team with input from a group final year MPharm project students. The questionnaire was reviewed by another group of final year students to determine face validity. The questionnaire included five questions specific to the demographics of the respondents, eight questions utilising a five point Likert scale to assess students' perceptions of the program's functionality, accessibility, content and relevance to the competency based class, and a free text box for comments and suggestions (Appendix 2.1). The questionnaire was released, following the degree assessment, through the VLE, SPIDER. It was available for two weeks to all students included in the study and a reminder message was sent after one week to encourage non-respondents to complete the questionnaire. All students were made aware that completion of the questionnaire was voluntary, that all responses would be anonymised and that responses could be used for on-going evaluation and development of SCRIPT. The responses to the Likert questions were analysed quantitatively and free typed comments were analysed thematically.

Staff perceptions were determined through informal interviews with staff involved in teaching the competency based class. Participants were asked what they thought of SCRIPT, what went well and what could be improved for the next academic year. Comments from the student questionnaire were used as prompts during the staff interviews to gain staff perspectives of these comments. To minimise bias teaching staff from the editorial team were not included in this study.

The staff and student feedback were used to help identify and prioritise refinements for SCRIPT. All comments were considered and prioritised according to ease of implementation and potential impact on learning outcomes. Queries to the SCRIPT helpline were noted to help inform refinements of the program.

2.3.8 Statistics

A Mann Whitney *U* Test was applied to determine if there was any significant difference in the use of SCRIPT between cohorts: the Bonferroni correction was used to minimise the risk of type 1 errors due to multiple measures. A Chi square was applied to determine if there was a correlation between SCRIPT use in preparation for an assessment and the proportion of students passing that assessment. Linear regression analysis was conducted to determine if there was a significant correlation between the CWA and SCRIPT access. All statistical analyses were conducted using the raw data and not the data that was corrected to use per 100 students.

2.3.9 Ethics

No ethical approval was required as this was a routine evaluation of a class within the University of Strathclyde as determined by the Departmental Ethics Committee.

2.4 Results and discussion

2.4.1 Demographics

In academic session 2007 – 2008 there was a total of 240 students in two cohorts. The Home cohort (n=123; 3 of whom were re-attending) was taught over the two traditional academic semesters between October and June and the Collaborative cohort (n=117) was taught in the compressed summer semester between June and September.

2.4.2 Pattern of use of SCRIPT in terms of access by Home and Collaborative cohorts

2.4.2.1 Access to SCRIPT

A total of 6889 attempts were made on SCRIPT during the study period: equating to 2875 attempts per 100 students. The Home students made 2289 attempts per 100 students compared to 3481 attempts per 100 students made by the Collaborative students (Table 2.2). A Mann Whitney *U* test indicated that the Collaborative cohort used SCRIPT statistically significantly more than the Home cohort (U = 4946, $p<0.001$).

Table 2.2 Details of student attempts at SCRIPT in academic session 2007 – 2008

Cohort	Number of students	Total number of attempts	Number of attempts per 100 students	Number of times accessed (median (IQR))
All students	240	6889	2875	23 (13 – 35.25)
Home	123	2816	2289	18.5 (12 – 31)
Collaborative	117	4073	3481	26 (19 – 41)

The Home cohort was the first cohort to use SCRIPT as an open access revision aid at a time when the staff involved in teaching the class were also being introduced to the new tool. During the teaching period for the Collaborative cohort the staff appeared to be more comfortable with the technology and appeared to encourage the students to make greater use of the tool. Lack of appropriate buy-in from

academic staff is a well known barrier to the introduction of new technology into education (Greenhalgh, 2001) thus increased staff familiarity may have influenced the Collaborative cohort's use of the tool. The Home cohort also had longer periods between teaching sessions and to prepare for the assessments thus they could discuss concepts with their peer group, tutors and during any part time employment in pharmacies. The absence of these factors in the Collaborative cohort has been recognised and may account for the greater use of SCRIPT to increase their familiarity with UK prescriptions. Further investigation is required to determine the extent and impact of these factors.

2.4.2.2 Access in relation to the 24 hour clock

The number of attempts made within each hour of the day shows that usage occurred throughout the day and evening with only a few hours of no use in the middle of the night (Figure 2.1).

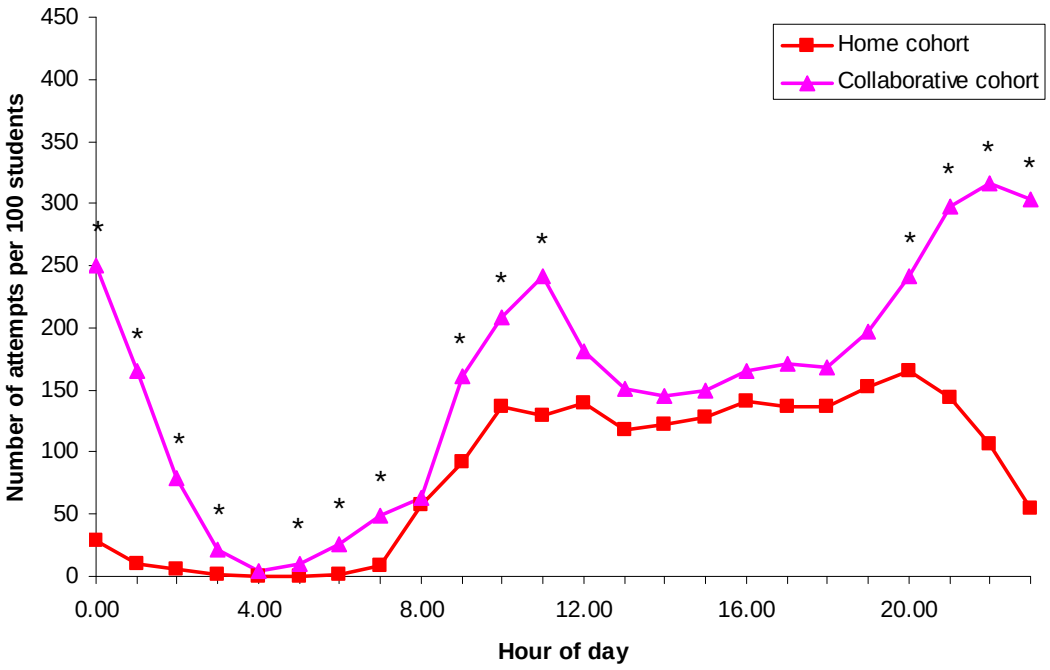

Figure 2.1 Access to SCRIPT over 24 hours standardised to 100 students – rolling average

Access to SCRIPT by the Home cohort occurred consistently between 09.00 and 22.00. There was very little activity on SCRIPT between 00.00 and 08.00 in this cohort. The Collaborative cohort demonstrated a more variable pattern of access with clear peaks between 10.00 and 12.00, and then again at 20.00 to 01.00. Compared to the Home cohort, the Collaborative cohort demonstrated some access to SCRIPT between 03.00 and 06.00: although this was less than 0.01% of their total access.

A Mann Whitney *U* test revealed that when comparing the two cohorts, the only time period for which access was not statistically significantly different was between 12.00 and 20.00. In general the Collaborative cohort made more attempts on SCRIPT at all hours except during the afternoon and early evening. There were two hours during which this generalisation did not apply, at 04.00 – 05.00 and 08.00 – 09.00. Between 04.00 and 05.00 there were very few attempts made by either cohort, and between 08.00 and 09.00 both cohorts demonstrated increased use of SCRIPT that was not statistically significantly different from one another. However, the Collaborative cohort's use increased further between the hours of 09.00 – 12.00 whereas the Home cohort's use started to level off at 10.00.

As can be expected the majority of attempts on SCRIPT occurred during normal waking hours. This was more evident with the Home students as there were no attempts made between 03.00 and 06.00 in this cohort; which is similar to the findings reported by Howlett et al, (2009), in relation to e-learning for undergraduate medical students. The Collaborative students did access SCRIPT overnight. This may be a reflection of the compressed nature of the Collaborative course, or perhaps due to the fact that many of the Collaborative students contact relatives in Malaysia at this time. This cohort demonstrated a peak in use between 20.00 and 01.00 which may relate to their study time following a 09.00 – 17.00 timetable with little free time. The peak in use between 09.00 and 12.00 for this cohort may be explained by an increase in use during these hours on a Saturday and

Sunday, or during assessment periods when there were no timetabled classes. The majority of the attempts made by the Collaborative cohort were between 17.00 and 09.00, when the academic staff are not traditionally available: highlighting the importance of SCRIPT as a revision aid. Freasier *et al* (2003) reported a similar finding with undergraduate chemistry students, indicating that greatest use of e-learning was between 23.00 and 01.00. In another study with health science students, Hall & Evans (2006) reported student use of web-based resources during all hours of the day. A common feature between this study and the literature is that e-learning has no time or location barriers allowing the students to undertake self-paced learning (Hall & Evans, 2006; Shih *et al*, 2008). Many of the staff believed that this was a key benefit of the introduction of SCRIPT because it reduced the demands placed on staff and also allowed the students more independent learning.

2.4.2.3 Pattern of use throughout the year

Analysis of the total number of attempts throughout the academic year (Figure 2.2) highlighted that students accessed SCRIPT shortly after the introductory sessions, which took place in weeks 5 and 36, for Home and Collaborative students, respectively. However, the majority of access occurred around the assessment periods.

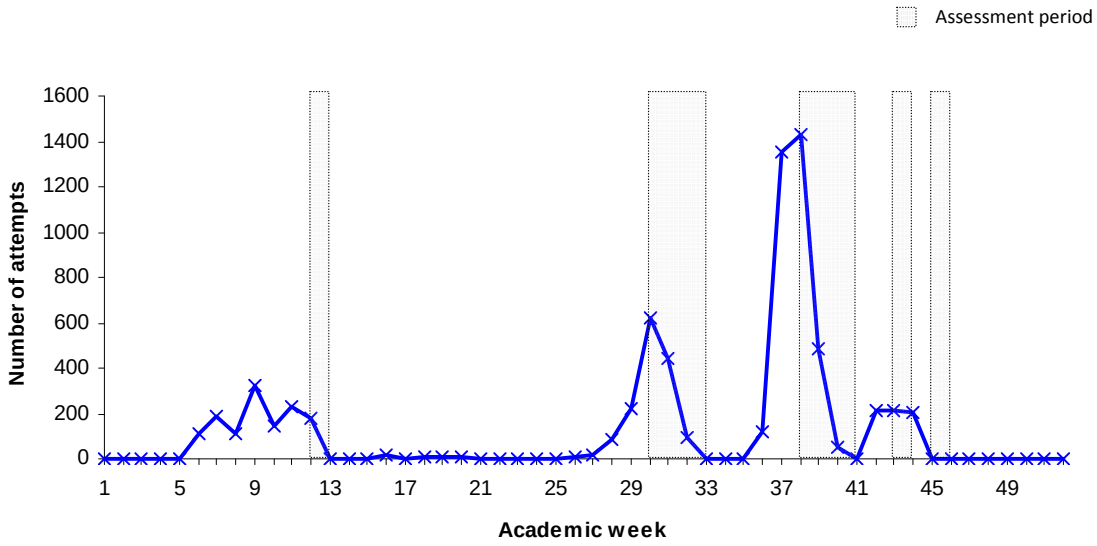

Figure 2.2 Number of attempts in relation to academic week

The pattern of use in the seven days before and immediately after the assessments showed that the majority of attempts occurred in the 24 hours immediately preceding an assessment (Figure 2.3a and 2.3b).

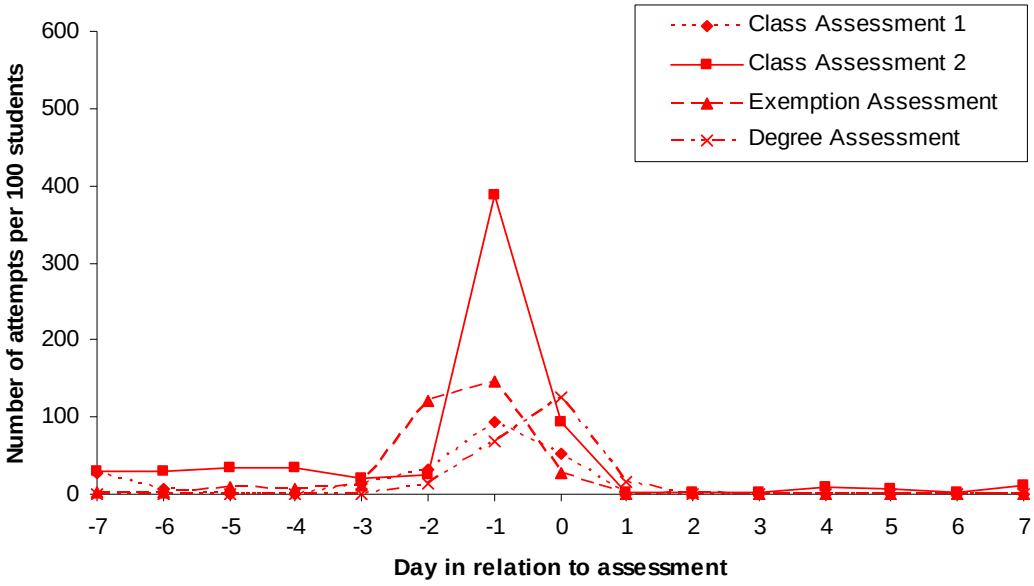

Figure 2.3a Number of SCRIPT attempts before and after assessments standardised to 100 students – Home cohort

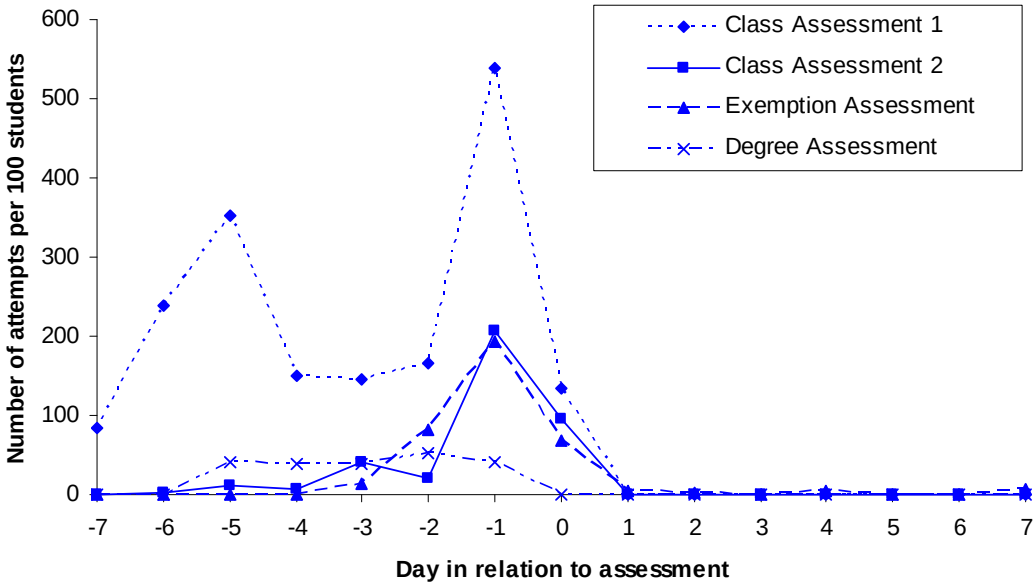

Figure 2.3b Number of SCRIPT attempts before and after assessments standardised to 100 students – Collaborative cohort

The increase in the number of attempts in the two days before the class assessments, suggests that students used SCRIPT as a revision tool immediately before the assessments. They did not however appear to use it after the assessments, suggesting that students did not see SCRIPT as a tool for checking their performance in the assessments. This pattern of use has also been shown in studies of medical students (Howlett *et al*, 2009; Tochel *et al*, 2011), business and IT students (Percival & Muirhead, 2009), and health science students (Hall & Evans, 2006) who all used on-line resources in preparation for examinations.

An exception to this finding is the clear peak approximately five days before class assessment 1, for the Collaborative cohort. This peak can be explained by the compressed nature of the Collaborative timetable. This cohort received their introductory session six days before the first assessment thus initial curiosity about SCRIPT may account for this peak. The Home cohort made a greater number of attempts at SCRIPT before class assessment 2, than before class assessment 1. This may be a result of the three month gap between class assessment 1 and class assessment 2, for the Home cohort. During this time there were fewer opportunities for the students to revise all prescription types during the taught sessions so students may have accessed SCRIPT to refresh their knowledge. The Collaborative cohort, who had less practical pharmacy experience before commencing the class than the Home cohort, may have used SCRIPT to become familiar with UK prescriptions. This may also help explain the greater use of SCRIPT by this group before the first class assessment.

2.4.3 Correlation between SCRIPT use and academic achievement in the class and Credit Weighted Average (CWA)

A Chi Square was used to determine if there was a significant difference in the number of students, from both cohorts, who passed an assessment if they had used SCRIPT during the assessment periods compared to those who chose not to access SCRIPT. There was a statistically significantly greater number of SCRIPT users who

passed class assessment 2 compared to non-users of SCRIPT (χ^2 = 8.27, p < 0.01) (Figure 2.4). Although the pass rate was greater for SCRIPT users than non-users for the other assessments, the difference was not statistically significant: class assessment 1 (χ^2 = 0, p = 1), exemption assessment (χ^2 = 0.37, p > 0.5) and degree assessment (χ^2 = 2.47, 0.5 >p > 0.1). Hall & Evans (2006) suggest any link between the use of e-learning and mark in an exam may be influenced by student conscientiousness and study skills, making it difficult to attribute any difference in exam performance with the web-based resource alone.

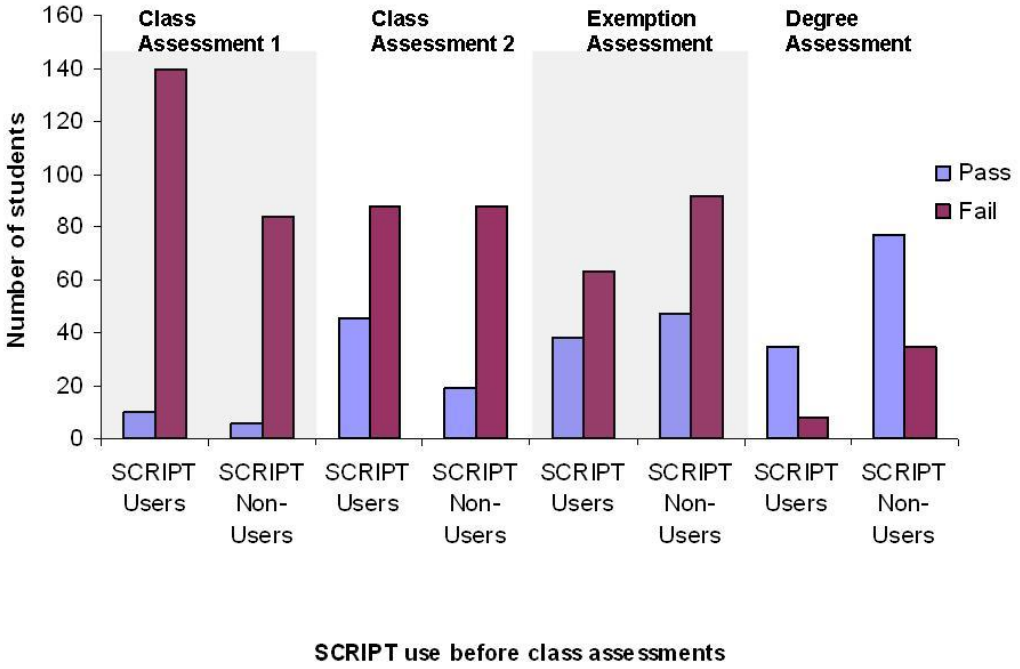

Figure 2.4 The number of users and non-users of SCRIPT who passed or failed each assessment

A recent meta-analysis of e-learning in healthcare professionals (Cook *et al,* 2008) highlights that internet based education can produce better achievement of learning outcomes when compared to no intervention, but comparable results to traditional educational methods. This meta-analysis was not directly comparable to the use of SCRIPT in undergraduate pharmacy students because it was not restricted to pharmacists, nor undergraduate students, and studies included in the review incorporated a broad range of e-learning interventions, such as; practice

exercises, web-based tutorials, virtual patients and video conferencing. In addition SCRIPT has been studied as an e-learning add on to traditional educational methods; therefore no comparison between SCRIPT and other instructional methods was available. As such, the findings here offer a slightly different view to the findings reported by Cook *et al* (2008), but this study supports the hypothesis that e-learning offers a suitable alternative to traditional methods and if designed and implemented appropriately it should not impede learning. The initial aim of SCRIPT was to provide a supplementary source of revision for students who choose to use it of their own will. Perhaps one reason why there was not a statistically different pass rate between users and non-users, other than for class assessment 2, is that by the time the students reached the exemption and degree assessments they were more aware of their own academic strengths and weaknesses. Therefore some students might not have required SCRIPT to further their knowledge and may have passed the assessments without the need for additional e-learning support. Alternatively other students might not have been able to pass the assessment, despite the additional resource that SCRIPT offers. At the time of class assessment 1, students were still new to the principles of dispensing practice and the format of the assessment. As such very few students passed this assessment regardless of whether they used SCRIPT or not.

The credit weighted average mark (CWA) of students was used as an index of their academic ability. There was a statistically significant correlation between the CWA and the number of SCRIPT attempts made by the student ($p < 0.01$) (Figure 2.5). A number of students ($n = 9$) were excluded from this analysis because they had not completed all classes required to allow their CWA to be calculated.

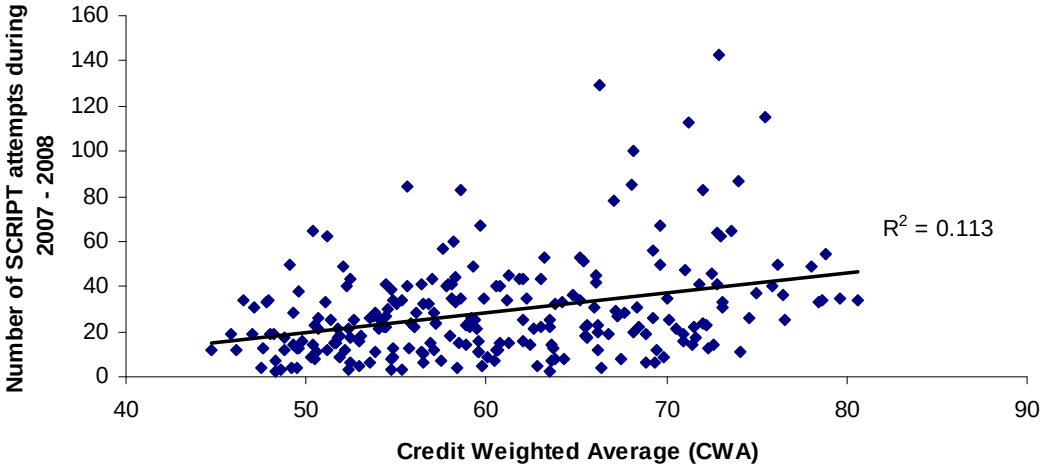

Figure 2.5 Number of SCRIPT attempts made by each student compared to their credit weighted average for the third year of the MPharm

This finding suggests that academic ability influenced the extent to which students used SCRIPT to aid their study, with higher performing students making greater use of SCRIPT. Although there was a statistically significant correlation between SCRIPT use and CWA, no consideration was made for other computer based activity, such as literature searching, emailing or use of discussion fora. Additionally, students may have chosen to use SCRIPT in different ways. Some students may have spent time trying to complete the scenarios as intended and other may have proceeded straight to the feedback section in an attempt to gain tips for the assessments. In a review of student use of technology, Oblinger & Oblinger (2005) reported that students with lower than average grades used computers predominantly for gaming and students with higher grades focussed their use of computers on support with class related activities. Therefore care must be taken when interpreting this finding because average marks are only one of many factors that may have influenced SCRIPT use. An evaluation questionnaire was used to help determine students' perceptions of SCRIPT, but further qualitative analysis may be helpful in determining what motivated students to use SCRIPT and how they describe their e-learning habits.

2.4.4 Evaluation of student and staff perceptions of SCRIPT

2.4.4.1 Student perceptions

Of a possible 240 students, 93 (38.6%) completed the online evaluation questionnaire (Table 2.3). The number of male and female students responding to the questionnaire were representative of the total cohort (χ^2 = 1.53; p > 0.05). However, there were proportionally fewer respondents from the Collaborative cohort than the Home cohort (χ^2 = 27.80; p < 0.01) which means that the findings may not be truly representative of the total population. Likewise, the students responding were not proportionately representative of the cohort in terms of the stage in which they had passed the competency class (χ^2 = 8.04; p < 0.05). There were a larger proportion of students who had passed the class at the exemption assessment compared to the degree assessment.

Table 2.3 Characteristics of questionnaire respondents

Characteristic	Respondents n (%)	Total Cohort (%)
Sex		
Male	24 (25.8)	73 (30.4)
Female	69 (74.2)	167 (69.6)
Cohort		
Home	68 (73.1)	123 (51.3)
Collaborative	25 (26.9)	117 (48.8)
Stage when class passed		
Exemption assessment	25 (26.9)	85 (35.4)
Degree assessment	54 (58.0)	112 (46.7)
Not passed Degree assessment	14(15.1)	43 (17.9)
SCRIPT used for revision		
Yes	76 (81.7)	n/a
No	16 (17.2)	n/a
Did not answer	1 (1.1)	n/a

The Likert scale responses (Table 2.4) reveal that the majority of students found that SCRIPT was user friendly, that the prescriptions were comparable to the

competency based class in terms of the scenario content and the level of difficulty, that SCRIPT was useful in identifying problem areas and that the feedback offered was useful. Sixty six of the 93 (71%) respondents agreed or strongly agreed that the program should be expanded to include additional prescription types.

The responses were very positive in terms of SCRIPT functionality and its use as a revision tool. Despite 76 (81.7%) of the respondents indicating that they had chosen to use SCRIPT for revision, the low completion rate means that there is a potential weakness in these findings because they might not be representative of the whole class.

Table 2.4 Student responses to the evaluation questionnaire

Comment	Response				
	strongly agree	agree	neutral	Disagree	strongly disagree
The tutorial was easy to use (n=93)	55	13	5	6	14
The instructions for this tutorial were easy to follow (n=93)	38	22	16	9	8
The tutorial was helpful in identifying problem areas (n=93)	28	35	14	11	5
The prescriptions were similar to the ones seen in the class (n=93)	28	23	19	16	7
The drop down menu was clear and easy to understand (n=92)	25	34	14	15	4
Feedback given in the tutorial was helpful (n=92)	35	23	19	9	6
The prescriptions in the tutorial were more difficult than in the teaching labs (n=93)	8	17	39	16	13
I would like this tutorial to be expanded to include other types of prescriptions (n=93)	38	27	10	9	9

Several common themes were identified in the free type comments (Table 2.5). Positive comments which highlighted the benefits of SCRIPT included "*a useful aid to studying*", and "*allowed me to look at examples that weren't in the class notes or labs*". Negative comments included "*I found the drop down menu confusing", "feedback could be improved",* and "*needs additional feedback*".

Table 2.5 Positive and negative themes from students' comments in the evaluation questionnaire

Positive themes	Negative themes
Variety in scenarios (labels, registers, endorsing) (13) Improved from pilot (10) Benefit to practice (7) Helpful feedback (5) Useful revision aid (5)	Layout of tabbed windows (9) Ambiguity of errors (8) Not aligned to class (3) Requires clearer instruction (3) Requires more feedback (2) Requires more scenarios (2) Font on prescriptions (1) Can only indicate errors, not resolve them (1) Marking could be improved (1) Not challenging enough (1)

Some of the themes may overlap or be interrelated, for example "benefit to practice" and "useful revision aid" may be interpreted to be very similar themes. The "useful revision aid" theme was allocated to comments that were specifically related to assessment preparation, where as "benefit to practice" theme was allocated when the comment was more generally related to pharmacy practice and could be extrapolated to a real life environment.

The "ambiguity of errors" was a common theme and was also raised on the email help line in advance of the questionnaire. This may have been less of an issue had there been clear instructions, detailing the editors' interpretation of the error wording: hence the negative theme "requires clearer instructions".

Feedback was mentioned in both a positive and negative context. The positive comments related to the speed with which the feedback was received and the negative comments highlighted potential additions, such highlighting useful resources for further reading, highlighting '*counselling points'* which students should consider when talking to patients and '*personalising*' feedback for each prescription by highlighting key points to consider.

2.4.4.2 Staff perceptions

Interviews with the two members of academic staff revealed that staff were happy with the program and were becoming more familiar with how it worked. However, the staff suggested two ways to improve the program: better alignment to the taught elements of the class, and better induction for academic staff.

Alignment to the competency based class

Staff felt strongly that the program could be aligned better to give students the option of reinforcing what was learned in the practical class. Staff would also be able to direct students to specific tests, in response to identified learning needs. Staff highlighted that this would be most effective if all staff teaching on the competency based class received training to make them aware of what is available within SCRIPT and how the program works. This would raise staff confidence and ability to answer simple questions raised by the students, as well as being able to direct students to the most appropriate elements of SCRIPT.

Better induction for academic staff

An element of uncertainty from a staff perspective was that those who had not been involved in SCRIPT development were not aware of the error codes that were available for selection, making it difficult to respond to requests for help. Students highlighted that they found the errors ambiguous but were able to tell staff what they thought was wrong with a prescription. Staff who were unaware of the error code options found it difficult to direct students to the answer required by SCRIPT. This made staff nervous when responding to requests for help, in fear of providing conflicting information. It was suggested that a staff induction and the development of a staff handbook would help staff become more familiar with SCRIPT and increase their confidence in promoting the program and responding to requests for help. This is important because staff engagement is essential for the success of e-learning (Greenhalgh, 2001; Childs *et al*, 2005; Cook & Dupras, 2008).

Staff and students commented that the feedback provided by SCRIPT was helpful, but suggested that it could be enhanced to provide more information to the user. The student suggestions for greater feedback are not surprising due to the remote nature of the program and the lack of discussion or explanation available from staff or peers. Immediate feedback has been highlighted as one of the key benefits of e-learning (McKimm, *et al* 2003), but it has also been highlighted as an important factor to be considered during program design (Cook & Dupras, 2004; Clark & Mayer, 2008).

2.5 Recommendations for future developments

In response to the finding of this study the following recommendations were made to develop SCRIPT.

1) Rationalise and clarify the error descriptions and make the selection of errors easier.
2) Align SCRIPT to the competency based class
3) Increase the number of scenarios
4) Enhance feedback within the scenarios
5) Improve staff functionality
6) Develop program instructions and introduction for staff and students

Rationalise and clarify the error descriptions and make the selection of errors easier.
Ease of use of the e-learning program is essential for learner compliance and if not addressed could be a barrier to acceptability (McKimm, 2003; Childs *et al*, 2005; Sun *et al*, 2008). The wording of the errors in SCRIPT version 3.0 was very specific but caused some confusion for the students who misinterpreted the meaning. In particular some students found it difficult to choose between "inappropriate dosing instructions" and "incomplete dosing instructions". This was identified in the feedback questionnaire and during class teaching. If students interpreted an error in a different way to the editors' intention, they would have selected an error that was then marked as incorrect by the program. Several students were disheartened by this because in real practice they would have resolved the situation by altering the prescription so that it was legal and clinically appropriate.

SCRIPT contained 40 errors listed in alphabetical order in a drop down list which made selection time consuming and confusing, as the student had to scroll through the full list of errors to select the most appropriate. Each time an error was selected from the drop down list, the list returned to the start which meant that error selection was time consuming if a student wanted to select more than one error. It

is important that the program is made more user friendly because the perceived ease of use can influence the acceptability (Davis, 1989; Sun *et al*, 2008).

It was recommended that a search facility was incorporated into the next version of SCRIPT to allow the students to find an error by typing part of the error and then matching with a smaller list. It was recommended that each error and a definition was listed in an easily accessible instruction manual and that additional feedback was provided which may reduce the number of incorrectly interpreted errors.

Align SCRIPT to the competency based class

Some of the students commented that SCRIPT was relevant to revision and practice in general, but there were a number of recommendations to improve alignment of scenarios to the topics in the competency class. This is consistent with recent literature highlighting the importance of integrating e-learning resources into established curricula (Genschichen *et al*, 2009; Grant *et al* 2011) and ensuring that resources are perceived as a core component of the course (Khogali *et al*, 2011). In addition, aligning the scenarios more closely to the content of the taught portion of the competency class may increase the students' perceived usefulness of the program, which can significantly influence acceptability (Davis, 1989; Sun *et al*, 2008). A clear link between the content of an educational resource and real life practice has been identified as an important element for the success of any educational resource whether specific to e-learning development (Clark & Mayer 2008; Cook & McDonald 2008; Wong *et al,* 2010) or to the principles of learning in adults (Knowles *et al*, 1998; Fraser *et al*, 2007; Cook & McDonald, 2008). As SCRIPT was created as a revision aid this is important as there is evidence to support the alignment of an e-learning program with class assessments (Clark & Mayer, 2008). Although SCRIPT was developed as a revision tool, the request for greater alignment to the competency based class suggests that SCRIPT may be used to help consolidate learning from the practical classes.

It was recommended that scenarios were grouped and linked to the individual teaching events. This could be achieved easily as the VLE allows tutorials to be released on specific dates and to be switched on and off as appropriate. This could be supplemented by the addition of class editor functionality that allows specific tests to be created and amended thus preventing the need for additional coding from the computer officer.

Increase the number of scenarios

A number of the students indicated that there should be more scenarios, of varying complexity, to cover all potential types of prescription. The version of SCRIPT used in this study did not contain enough scenarios to allow alignment of tests for each of the taught topics.

It was recommended that the existing SCRIPT scenarios are mapped to the competency based class and that the number of scenarios are increased to ensure a range of scenarios of varying complexity for each class topic.

Enhance feedback within the scenarios

In SCRIPT, students were provided with feedback on whether their response was correct or incorrect, and they received standard comments for each incorrectly selected error. However students did not feel that this feedback gave enough of an explanation and as a result staff received e-mails requesting for further explanation relating to specific scenarios. While enquiring minds were not discouraged many of the queries were common and it is more efficient to provide the feedback at the time the student undertakes the exercise.

It was recommended that the standard feedback linked to each error is removed because in some instances the explanation did not make sense. For example, if the error “words and figures are missing” is selected inappropriately the feedback provided would include “words and figures are present on the prescription”. This

only makes sense for controlled drug prescriptions, so the feedback is not appropriate in all situations. This may have had a negative effect on the perceived quality of SCRIPT and as such may have influence user satisfaction (Sun *et al* 2008).

It was recommended that a series of standard statements were created and then applied, with adaptation if required, for every scenario. This would ensure that all feedback provided to the user is tailored to the individual scenarios. This would ensure that there is some standardisation with the added reassurance that feedback is relevant. These recommendations may be time consuming to implement and there are inherent problems that the feedback has to remain current and will need to be updated based on changes in legislation. However, corrective and explanatory feedback is recommended according to current best practice in e-learning (Clark & Mayer, 2008) as this helps students to understand the significance and relevance of errors that they make. These changes should improve the user experience of SCRIPT and reduce the number of follow up emails to staff.

Improve staff functionality

Staff were positive about the use of SCRIPT but they indicated that they had a lack of familiarity with the program and implied that a feeling of greater involvement with SCRIPT would improve their experience of the program. During the study period the students could access a summation of their errors to help them identify the areas in which they needed to direct their studies but no such feature was available to staff.

Although not in response to suggestion from staff to have increase functionality of SCRIPT, it was advised that the program is enhanced to allow a version of the error summary feature which can be limited to a particular date range, so staff can identify the class's weak points and thus tailor tutorials. This may help provide "just in time" teaching to address problems before they appear.

Develop program instructions and introduction for staff and students

There were a number of comments indicating confusion with the interpretation of error codes and 20 of the 93 students (21.5%) disagreed or strongly disagreed that SCRIPT was easy to use. As highlighted previously, this could have a negative effect in relation to user acceptability and usage of SCRIPT (Davis, 1989). Pituch & Lee (2006) advise that to enhance the perceived ease of use and usefulness of an e-learning resource, developers should consider including a demonstration and instructional material to support learners.

It was recommended that a student instruction manual is developed to provide students with guidance after the introductory lecture. It was also recommended that a staff handbook be developed, which should include all the information contained in a student instruction manual with the addition of information relating to staff specific functions, such as the error summary feature. In addition it was advised that an introductory tutorial was made available for all academic staff teaching on the competency based class, before the start of the academic year. It was hoped that this will allow staff to respond to questions from students more confidently and improve continuity in the responses student receives.

2.6 Conclusion

The analysis of the use of SCRIPT in academic year of 2007 – 2008 demonstrated that the program was accessed by the majority of the student cohort during the year and was highly valued by the students, particularly as a revision tool before class assessments. Students appreciated the benefits of the tool which was accessible at times that suited their revision needs, but highlighted areas of development from which a number of recommendations were made.

Chapter 3

Comparison of the Supplemental and Replacement models of integration of SCRIPT Version 4.0 into a competency based pharmacy class

3.0 Comparison of the Supplemental and Replacement models of integration of SCRIPT Version 4.0 into a competency based pharmacy class

3.1 Introduction

SCRIPT was further developed in the summer of 2008 in response to the findings of the study completed in academic year 2007 – 2008. Each of these developments was consistent with current evidence supporting effective e-learning programs.

Rationalisation and clarification of the error descriptions and easier error selection

To improve error selection a filter was added to the program so that students could type part of a word to limit the options available to a subset of the complete list. Limiting the number of options visible allowed the students to compare errors with similar key words, and then make the most appropriate selection. Definitions of each error were included in the student instruction manual, and students were encouraged to use this as a reference when using the program. This development is important when considering Davis's Technology Acceptance Model (Davis, 1989) as a guide to developing e-learning. Davis advises developers to consider the importance of the learners' perceived usefulness and ease of use of a resource because this will impact on how well the resource is accepted. Studies into the impact of Davis's Technology Acceptance Model on learner acceptance of e-learning in undergraduate students (Sun *et al*, 2008) and medical education (Wong *et al*, 2010) both report the importance of ensuring that a resource is perceived as easy to use. In turn, this perceived ease of use of a resource can directly influence the perceived usefulness of that resource (Pituch & Lee, 2006), which also indicates the importance of this refinement.

Alignment of SCRIPT to the competency based class and the increased number of scenarios

Students and staff requested that individual tests specific to each taught element of the course were available and released at the same time as the taught session. In response to this all prescriptions were categorised and grouped to align with the

learning objectives of each of the practical classes (Table 3.1). SCRIPT was adapted to allow the editorial team to create and edit individual tests, selecting a start date and time so that tests would become accessible automatically to coincide with laboratory teaching.

Table 3.1 The SCRIPT tests created in alignment with the practical classes

Practical Class	Aligned SCRIPT test
Orientation	Practise
Health Service prescriptions	NHS prescriptions
Private prescriptions	Private
Controlled drugs I	Controlled drugs 1
Controlled drugs II (calculations)	Controlled drugs 2
Dilution of doses, paediatric doses, liquid preparations, instalment prescriptions	Paediatric
Dental prescriptions, nurse prescriptions	Dental prescription Nurse prescription
Emergency supply at doctor's request	Emergency – doctor request
Emergency supply at patient's request, veterinary prescriptions	Emergency – patient Veterinary
Sale of POMs to authorised persons, items liable to abuse	No test
Drug interactions	Interactions

Students requested that the variety of scenarios be increased to reflect all types of prescription or scenario available in the competency based class. During the alignment process all scenarios were reviewed based on the type, complexity and relevance to the competency based class. New scenarios were created to ensure that there were adequate numbers of all simulated prescription types. Teaching staff indicated that approximately 10 – 20 examples of each prescription type would be adequate but a greater number would be advantageous. The new scenarios were provided by practising pharmacists and were compared to the scenarios covered in the practical class to ensure that they were representative but not duplications. This resulted in a total of 400 examples available for academic year 2008 – 2009 covering all prescription types (Table 3.2).

Table 3.2 The number of scenarios for each prescription type available in 2007 – 2008 and 2008 – 2009 & 2009 – 2010 cohorts

Prescription type	Number of scenarios in 2007 – 2008	Number of scenarios in 2008 – 2009 / 2009 – 2010
NHS GP prescriptions	138	228
Private GP prescriptions	9	32
Nurse prescriptions	13	24
Dental prescriptions	22	27
Paediatric prescriptions	16	27
CD prescriptions	13	51
Emergency supply – Patient request	1	14
Emergency supply – GP request	3	25
Veterinary prescriptions	4	25
Labels	0	24
Registers	0	29
Interactions	0	50

Note that some scenarios cover more than one prescription type

The scenarios in the aligned tests were released to coincide with class teaching during the academic year 2008 – 2009 and then further integrated to form part of the taught practical class in 2009 – 2010. The importance of integration of e-learning into established curricula is well documented (Genschichen *et al*, 2009; Grant *et al* 2011; Khogali *et al*, 2011) as is the need to demonstrate the relevance of the e-learning in relation to real practice (Clark & Mayer 2008; Cook & McDonald 2008; Wong *et al,* 2010). In relation to SCRIPT, real practice may be considered to be the practice within the competency based class.

Enhanced feedback within scenarios

All prescriptions in the program were reviewed for validity by the editorial team. The standard feedback from SCRIPT version 3.0 was removed as students highlighted that the generic feedback did not always apply to errors on specific types of prescription. For example in SCRIPT version 3.0, when a student selected

the error "*total quantity also requires words*", for a prescription that does not require a total quantity in words, they would have received the feedback "*the total quantity is already expressed in words*".

To resolve this problem feedback, using key phrases to ensure consistency, was written and then tailored to each prescription. The individualised feedback was also used to emphasise the relevance of the scenario to real life practice, by adding additional information and considerations, such as counselling points or highlighting reference texts. Immediate feedback has been highlighted as one of the key benefits associated with e-learning resources (McKimm, 2003) and it is encouraged that feedback is incorporated into any e-learning resource because this may reduce barriers to successful implementation of the resource (Childs *et al*, 2005). However, Clark & Mayer (2008) highlight the importance of explanatory feedback, as opposed to corrective feedback, because this has been shown to produce better learning through correction of misconceptions. In addition, it is good practice to display the feedback, the question and the users' responses on the same screen so that the user can analyse all the information presented when reviewing the feedback. These recommendations were present in SCRIPT version 3.0 so care was taken to ensure that program complied with these guidelines once the enhancements were made.

Improved staff functionality

SCRIPT was enhanced to allow academic staff to view a summary of errors made by a particular cohort of students, in a defined time period. The intention of this refinement was to help staff identify errors which were made by a large proportion of the class, so that teaching could be targeted in response to this information. Additional limits could be selected to allow staff to view common errors made for a particular prescription type. It was hoped that this would help improve staff engagement with SCRIPT which is important for the success of e-learning (Greenhalgh 2001; Cook & Dupras, 2004).

Instructions and introduction for staff and students

In response to requests made by both students and staff for greater information on SCRIPT and the changes to SCRIPT detailed student instructions (Appendix 1.2) and a staff handbook were developed. These covered the purpose and functions of SCRIPT, how to use the program, the meaning of each error code, how to interpret feedback, dealing with technical problems and where to find help. The staff handbook additionally contained information about accessing the summary of class errors.

In addition to the written instructions, students received an introductory lecture and a staff led tutorial before the first practical session. This was intended to give the students the opportunity to use SCRIPT in a supportive environment and to ask questions directly to the editorial team. The combination of a live demonstration and instructional material has been reported to be an optimal approach to introduce e-learning technology (Pituch & Lee, 2006).

All staff involved in delivering the practical elements of competency based class were encouraged to attend the introductory tutorial in September 2008. Staff were also asked to attend a formal tutorial in September 2009, in preparation for the integration of SCRIPT into the practical class.

3.2 The need for evaluation in relation to e-learning research

Twigg (2003) describes five models for the use of e-learning to enhance academic curricula: Supplemental, Replacement, Emporium, Fully online and Buffet. For each of these models, Twigg (2003) highlights a number of positive differences in academic achievement of students who undertook the post-redesign curricula when compared to students who undertook the traditional curricula. Some of the differences identified include reduced drop out rates, improved class averages, and increased pass rates. However the evaluations were not conducted in a consistent manner so cannot be compared directly.

The use of SCRIPT during the 2007 – 2008 academic year, evaluated in Chapter 2, is an example of Twigg's Supplemental model as it retains the original course structure but adds optional technology to enhance learning. The refinements made to SCRIPT for the 2008 – 2009 academic year did not alter the model of curricula as defined by Twigg, but the refinements were intended to increase usability of the program, allow students the ability to target their revision, and increase the number and variety of scenarios. The intention of this was to enhance the student experience by increasing the perceived relevance of SCRIPT in relation to examination preparation and pharmacy practice teaching. The perception of relevance of an e-learning program to the student has been reported as an essential consideration when developing learning and revision aids (Clark & Mayer 2008). The use of SCRIPT as a supplemental program, which is available to students remotely 24 hours a day and which has scenarios grouped and released to correspond with the taught course will be to referred as the Supplemental use of SCRIPT and the academic year 2008 – 2009 will be referred to as the Supplemental year.

There is evidence to support further incorporation of e-learning into practical classes. For example, Childs *et al,* (2005) reported that the incorporation of e-learning into practical classes can increase value to the student and Kumta *et al,* (2003) highlighted improved assessment results in a competency class for medical

students when e-learning was incorporated into the teaching. The further alteration to the use of SCRIPT, in academic year 2009 – 2010, was the integration of SCRIPT into class teaching: replacing one member of teaching staff in each laboratory session. This follows the logic of Twigg's Replacement model where part of the original curriculum is replaced by an e-learning alternative. This will be referred to as the Replacement use of SCRIPT and the academic year 2009 – 2010 will be referred to as the Replacement year.

It had not been determined whether alignment of SCRIPT scenarios to the taught course or complete integration into the practical classes would be beneficial for undergraduate learning. Current research indicates the importance of adequate integration into existing curricula to ensure effective implementation of e-learning technology (Childs *et al*, 2005, Gensichen *et al*, 2009, Grant *et al,* 2011, Khogali *et al,* 2011). However, at the time of the study there was no literature comparing the Supplemental and Replacement models of e-learning integration. This study aimed to compare the differences in use and perception of SCRIPT following two models of integration into a competency based practical class.

3.3 Aim and objectives

The aim of this study was to compare, over two academic years, the effect of greater alignment and integration of SCRIPT within the competency based class with respect to student use and perception, staff perception, and academic achievement.

The objectives of this study were to

- describe the student use of SCRIPT in terms of total access, access in relation to time of day, day of the week, academic week/week equivalent and access immediately before and after class assessments.
- describe student access to individual tests in relation to overall access, test release dates, and access immediately before and after class assessments.
- compare the student use between the two cohorts and subgroups
- determine if there was a difference in pass rate of the competency based class between the Supplemental and Replacement cohorts.
- determine student and staff perceptions of SCRIPT as a Supplemental or a Replacement program.
- make recommendations for future development.

3.4 Population and setting

Student inclusion and exclusion criteria

Supplemental cohort (2008 – 2009 academic year)

All students from both the Home and Collaborative subgroups who were enrolled in the competency based class were permitted voluntary, remote access to SCRIPT. The Home students were all students who studied all four years of the MPharm at the University of Strathclyde and Collaborative students were students who studied two and a half years at the International Medical University in Kuala Lumpur and a full calendar year at the University of Strathclyde. Students who were re-attending the class were also permitted voluntary, remote access and were included in this study.

Students who were not enrolled on the competency based class were excluded from this study.

Replacement cohort (2009 – 2010 academic year)

In the Replacement cohort the same inclusion and exclusion criteria were applied as in the Supplemental cohort. The Home students were students who studied all four years at the University of Strathclyde, and students who studied on the MPharm 2+2 programme. The 2+2 students had studied for 2 years (4 semesters) at the International Medical University, Kuala Lumpar and were in the process of completing the first of 2 years (4 semesters) at the University of Strathclyde. This difference was as a result of a change in recruitment policy at the University of Strathclyde and the accreditation by the General Pharmaceutical Council (GPhC) of the 2+2 degree.

Staff inclusion and exclusion criteria

All staff who were involved in teaching the competency based practical laboratories were included in this study. Staff who were not involved in teaching the

competency based class or who were part of the SCRIPT editorial team were excluded.

Availability and introduction of SCRIPT

Supplemental cohort

SCRIPT was made available to the students through the University of Strathclyde VLE, SPIDER, 24 hours a day from the 13th October 2008 to 26th May 2009 for the Home students and from 15th June 2008 to 1st September 2009 for the Collaborative students.

The individual SCRIPT tests were released in alignment with the taught class (Table 3.1). There was no dedicated time during the laboratory sessions for the students to access SCRIPT.

Replacement cohort

SCRIPT was made available to the students through the University of Strathclyde VLE, SPIDER, 24 hours a day from the 5th October 2009 to 24th May 2010 for the Home students and from 14th June 2010 to 31st August 2010 for the Collaborative students.

The individual SCRIPT tests were released in alignment with the taught class (Table 3.1). SCRIPT was a compulsory station in the practical class, replacing a member of academic staff in each of the taught classes. SCRIPT was also available outwith class teaching. During the class students were asked to reflect on their performance, review the feedback and identify any learning needs from their use of the program. Due to constraints on the number of computers available in the teaching lab the students could access the program either individually or in small groups.

Introduction to SCRIPT

All students received an introductory demonstration of SCRIPT in a lecture format, delivered by the editorial team, and an additional practical introduction delivered in a laboratory class. During the practical element students were split into groups of two or three students to allow all students to have sight of a computer. Students were encouraged to use SCRIPT and ask questions during the workshop. This approach is commonly used to introduce an e-learning resource to undergraduate students (Pituch & Lee, 2006).

All students were advised that SCRIPT was available as an optional study tool to consolidate their learning from the practical class and as a revision aid to help them prepare for the class assessments. The students in the Replacement cohort were additionally advised that SCRIPT was an essential component of the taught practical class.

Program version

SCRIPT version 4.0 was used in this study and contained the developments made in response to the findings of the 2007 – 2008 study, including the detailed instruction manual. The SCRIPT program was identical for both cohorts, except for changes to reflect legal or clinical amendments required to ensure the program was up to date. In addition to the aligned tests, label, register and revision tests were available as revision only tests as preparation for the exemption assessment and degree assessment.

3.5 Methods

3.5.1 Data collection

SPIDER automatically recorded every access to a triplet of scenarios (Table 3.3), which was exported to an Excel spreadsheet for analysis.

Table 3.3 Data automatically recorded by SCRIPT

Title	Description
ID	A chronological number relating to the attempt of a SCRIPT triplet of scenarios.
Username	The unique identifier of the individual accessing SCRIPT (student number) which was anonymised.
Test ID	The unique identifier of the test selected.
Results	The results achieved from the triplet of scenarios attempted, containing the final score for each scenario and details of each error made.
Score	The cumulative score of the three scenarios in the triplet.
Date and time	The date and time that the triplet of scenarios was first accessed.
Session	The academic year in which the access was made (from October to September).
Completed	1 or 0 to indicate if the user completed all three scenarios.

The data were cleaned to remove any records relating to excluded students or staff. Any entries relating to access before or after the study period were also removed. Entries relating to a scenario which was opened but not attempted which therefore contained no information in the answers column were excluded from the analysis.

3.5.2 Data analysis

3.5.2.1 Pattern of SCRIPT use

Data were interrogated to determine the number of SCRIPT attempts made for each cohort and subgroup. A subanalysis of the Replacement cohort was made to determine the use of SCRIPT in class and outwith timetabled teaching. All data were corrected to use per 100 students to account for differences in cohort size at each

stage of the analysis. All statistics were calculated using the raw data rather than corrected data.

Use in relation to time of day

Data were sorted according to the time, in hour blocks, at which an attempt was made. The number of attempts made in each hour was counted for the each cohort and subgroup. A rolling average was applied, taking the average of three points, to display the access trends over the day taking account of attempts which straddle more than one hour. For the Replacement cohort a subanalysis was conducted to determine SCRIPT use during timetabled teaching. Half hour blocks were used during this subanalysis to reflect the half hour intervals used for each station in the class.

Use in terms of day of the week

Data were sorted according to the day of the week on which an attempt at SCRIPT was made. The number of attempts made on each day was counted for each cohort and subgroup. For the Replacement cohort a subanalysis was conducted to determine SCRIPT use during timetabled teaching, during which the number of attempts was further adjusted according to the number of students who were in the timetabled class on a given day.

Use in terms of academic week/week equivalent

Data were sorted according to the date on which an attempt on SCRIPT was made. All data were labelled to indicate which academic week or week equivalent an attempt was made. The academic week, running from Monday to Sunday, was used for the Home subgroups, whereas a week equivalent was used to label data relating to the Collaborative subgroups. For this subgroup a week equivalent was determined to be either the Monday and Tuesday, Wednesday and Thursday, or Friday, Saturday and Sunday relating to which topic was taught on the Monday, Wednesday or Friday practical sessions respectively. Access that occurred during a

taught class, in the Replacement cohort, was adjusted to account for the number of students who had access in that class.

Pattern of the access to individual topics

Data were manipulated to determine the number of attempts made on each test, for each cohort and subgroup, both over the course of the year and in relation to the taught classes.

3.5.2.2 The relationship between SCRIPT use and the pass rate for competency based class for the Supplemental and Replacement cohorts

SCRIPT access data and data relating to class achievement were matched anonymously by a third party using the nine digit student registration numbers. SCRIPT access data were analysed to determine the total number of remote attempts made by each student during the academic year then compared with their mark in the competency based exemption and degree assessments to determine if there was any correlation between SCRIPT use and class mark.

3.5.2.3 Evaluation of student and staff perceptions

Student perceptions

Students who studied in the Replacement year were selected at random and invited to participate in a semi-structured interview to determine how students used SCRIPT in class and remotely in their own time, if anything had influenced students to use SCRIPT in their chosen manner outwith the class and to identify their opinions about SCRIPT and if they would recommend any changes to SCRIPT.

The interview structure was designed by the SCRIPT editorial team (Appendix 3.1). The interview structure was tested on two final year pharmacy students to determine if the questions were understandable from a student perspective. To reduce the risk of bias interviews were conducted by final year pharmacy students who received interview training and followed the interview schedule. Interviews

were recorded then transcribed verbatim. The data were analysed horizontally, by reviewing the responses made by each student for each of the questions, then vertically by reviewing each student interview as a whole transcript (Smith, 2002). During the analysis data were coded and then concepts were identified, before agreeing overarching themes with the PhD supervisor (Länsisalmi *et al,* 2005).

Staff perceptions

In August 2011, all staff who met the inclusion criteria and were actively teaching on the competency based class were invited to participate in a semi structured interview (Appendix 3.2) designed to identify the staff member's awareness of how students used SCRIPT during teaching and personal study time, determine what staff thought of the way that SCRIPT was aligned to competency based teaching (Supplemental), determine what staff thought about the way that SCRIPT was integrated into competency based teaching (Replacement) and identify what changes staff thought could be made to SCRIPT.

The interview structure was designed by the SCRIPT editorial team. All interviews were recorded and transcribed verbatim. The data were analysed horizontally, by reviewing the responses to individual questions made by each member of staff, then vertically by reviewing each staff interview as a whole transcript (Smith, 2002). During the analysis data were coded and then concepts were identified before agreeing overarching themes with the PhD supervisor (Länsisalmi *et al,* 2005).

3.5.3 Statistics

A Mann Whitney *U* Test was applied to determine if there was any significant difference in the use of SCRIPT between cohorts and subgroups: the Bonferroni correction was used to minimise the risk of type 1 errors due to multiple measures. A Friedman's Pairwise comparison was used to determine if there was any statistical difference in the number of SCRIPT attempts made within each cohort and subgroup, for each hour of the day and day of the week. A Chi square was

applied to determine if there was a correlation between SCRIPT use in preparation for an assessment and the pass rate for that assessment. All statistical analyses were conducted using the raw data and not the data that was corrected to use per 100 students. All statistical analyses were completed using PASW statistics (SPSS) version 18.

3.5.4 Ethics

No ethical approval was required as this was a routine evaluation of a class within the University of Strathclyde as determined by the Departmental Ethics Committee.

3.5.5 Future developments

The results from the quantitative analysis of log on data and the information obtained from the qualitative interviews were reviewed in reference to published literature. Recommendations were made for potential developments of SCRIPT and future research priorities.

3.6 Results

3.6.1 Demographics

The populations (Table 3.4) of each cohort were categorised.

Table 3.4 Population demographics

Subgroup	Supplemental (2008– 2009)	Replacement (2009– 2010)
Home (total)	127	145
Home (4)	127	117
Home (2+2)	0	28
Collaborative	114	72
Total	241	217

3.6.2 Student use of SCRIPT in terms of overall access

The Supplemental cohort accessed SCRIPT more often per 100 students than the Replacement cohort. Remote access, which was considered to be any attempt at SCRIPT outwith the practical class, was statistically significantly greater for the Supplemental cohort than the Replacement cohort (U = 16851, $p<0.01$). Subgroup analysis revealed that the Home students accessed SCRIPT more often than the Collaborative students in both cohorts (Table 3.5). Six students (2.5%) in the Supplemental cohort and 31 students (14.3%) in the Replacement cohort did not access SCRIPT in their own time.

Table 3.5 Summary of student access for Supplemental and Replacement cohorts

Cohort	Remote attempts per student (median (IQR))	Remote attempts per 100 students	Total attempts per 100 students
Supplemental	**35 (19 – 62)**	**4882**	**4882**
Home	44 (28.5 – 78.5)	6409	6409
2 + 2	n/a	n/a	n/a
Collaborative	25 (13.25 – 44.75)	3098	3098
Replacement	**16 (4 – 39)**	**3048**	**4352**
Home	23 (5 – 48)	3782	5122
2 + 2	10 (4.75 – 16.75)	2129	3460
Collaborative	13 (1.75 – 23)	2214	3445

An initial comparison of the Supplemental and Replacement cohorts suggests that the total number of attempts made decreased after SCRIPT was made available in class teaching. However, the comparison of the total number of attempts between the cohorts may not be a true reflection of access when determining use as each student did not have a dedicated computer during the teaching sessions. In the Replacement cohort up to three students could have been accessing SCRIPT as a small group sharing a computer in class. Unless stated otherwise the majority of comparisons made relate to remote access, which is assumed to be self directed, individual access.

There were clear differences in the extent to which Home students and Collaborative students used SCRIPT. Timetabling may account for the fewer number of attempts made by the Collaborative students compared to the Home students. The compressed nature of the Collaborative timetable meant that the students in this subgroup had access to SCRIPT for a shorter time than the Home students.

For the Replacement cohort the Home2+2 students accessed SCRIPT to a similar extent to the Collaborative students despite the fact that they were taught over two semesters (U = 970.5, P > 0.5). Further qualitative analysis through semi structured

interviews, was conducted to determine how these subgroups used and perceived SCRIPT, to help establish if there was any correlation between Malaysian culture and the use of SCRIPT.

Student use of SCRIPT in relation to the 24 hour clock

Comparison of Supplemental and Replacement cohorts

Access outside class teaching (remote) in relation to the hour of the day followed a similar pattern for both the Replacement and Supplemental cohorts (Figure 3.1). There were statistically significantly fewer attempts made between 09.00 and 01.00 for the Replacement cohort than the Supplemental cohort (Mann Whitney, $p<0.05$). There was an increase in the number of attempts made at around 20.00 for both cohorts and this maybe explained by Home students who were still active on SCRIPT at this time and Collaborative students who were increasing their evening use at this time (Figures 3.1 and 3.2) as shown in the previous study. The majority of attempts made between 09.00 and 17.00 occurred in the revision period before assessments and not during the taught component of the year.

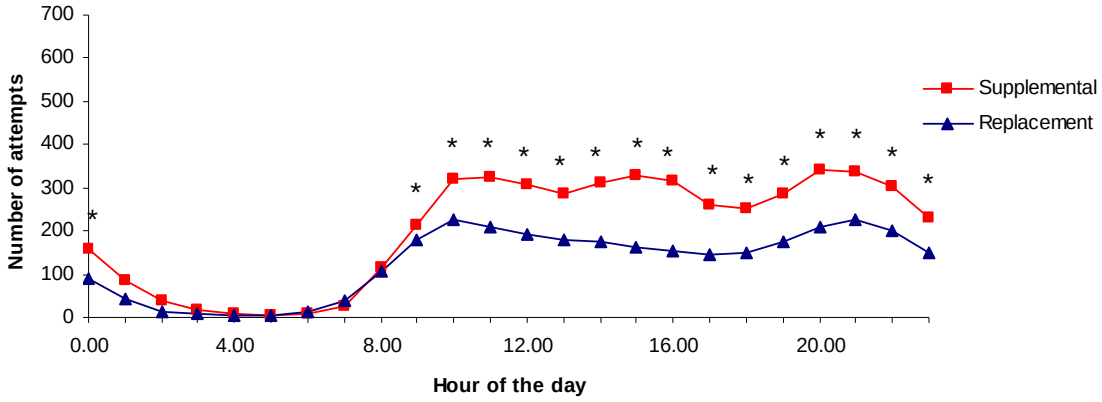

Figure 3.1 Rolling average of remote access for Supplemental and Replacement cohorts.

Subgroup analysis

In the Supplemental cohort, the Home students demonstrated three peaks in access; around 11.00, 15.00 and 20.00. For the Collaborative students, there were only two peaks in access; around 10.00 and 22.00 (Figure 3.2), with statistically significantly fewer attempts per 100 students at all hours except from 03.00 to 09.00 and between 20.00 and 23.00 (Mann Whitney, $p < 0.05$).

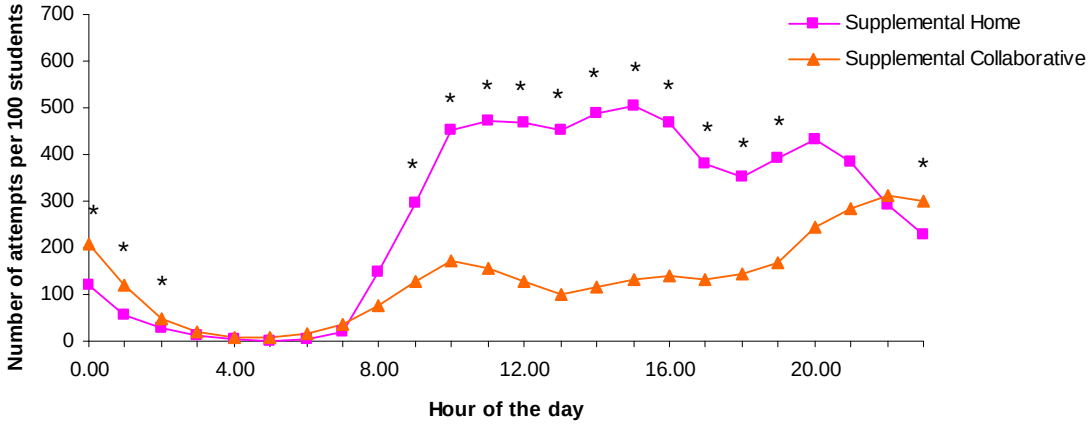

Figure 3.2 Supplemental cohort: rolling average of remote access per 100 students in relation to the 24 hour clock

In the Replacement cohort, both subgroups demonstrated consistent access outwith class teaching between 08.00 and 00.00. There was peak in access at 10.00 in both subgroups and then again at 21.00 and 22.00, for the Home and Collaborative subgroups respectively (Figure 3.3). A Mann Whitney *U* test indicated that there were only five hours in the day that access was statistically significantly different between the subgroups ($P < 0.05$).

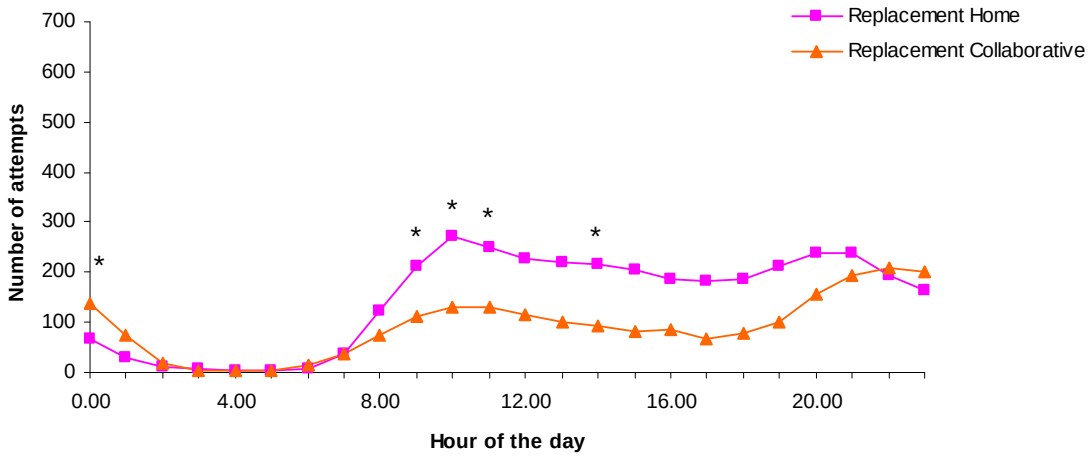

Figure 3.3 Replacement cohort: rolling average of remote access per 100 students in relation to the 24 hour clock.

The pattern of access for the two subgroups was similar in both the Supplemental and Replacements cohorts, with a peak in the number of attempts in the morning, followed by consistent access, and then a peak in the evening, before access drops at night time. This is understandable, with greatest access during waking hours and least during the night, particularly between 02.00 and 07.00. Access in the evening was common in both subgroups, suggesting this is a preferred study time.

There was an additional peak observed during the day for the Home subgroup in the Supplemental year, but this was not observed in the other subgroups. The Collaborative students made 35.7% and 40.3% of their attempts between 20.00 and 01.00 in the Supplemental and Replacement cohorts respectively. While this suggests greater preference for using SCRIPT in the evening and at night compared to Home subgroups who made 20.7% (Supplemental) and 25.7% (Replacement) of their attempts at this time, there was no statistically significant difference between the groups at these time points. This trend may be attributed to the fact that the Collaborative students had limited time to access SCRIPT between 09.00 and 17.00 due to the compressed nature of their teaching where they are in class most of the day and because they phone relatives in Malaysia during the night so might have

been awake later than the Home cohort. On the other hand, the Home students had time between semesters when revision was entirely self directed which might explain the greater use observed during the day.

In the Supplemental cohort a dip in activity between 17.00 and 20.00 for the Home students can perhaps be explained by students stopping to eat or commuting home before recommencing study. The Collaborative subgroups and the Home subgroup of the Replacement cohort did not demonstrate this trend in activity. Any effect associated with commuting may have been negligible for the Collaborative subgroups because these students all lived on campus, but further investigation would have to be completed to explain the differences observed between the Home subgroups.

A literature search did not identify any studies that compared student access in relation to time of the day following two different models of integration. However, in a study of undergraduate medical students' usage of e-learning, students demonstrated similar access trends to the home students with the majority of attempts made during normal waking hours (Howlett *et al*, 2009). However a study of post-graduate medical students demonstrated similar trends to the Collaborative students, with greatest access in the evening and during the night (Tochel *et al*, 2011). Although the Collaborate timetable and the vocational medical curricula may not be directly comparable, these findings suggest that learners will access e-learning when they have time, which may be dictated by other educational or work commitments. In other reports of e-learning usage in relation to the time of the day, undergraduate health science students used e-learning resources at all times of the day (Hall & Evans, 2006), and undergraduate chemistry students demonstrated a clear preference for use between 23.00 and 01.00 (Freasier *et al,* 2003). It is not clear why there were differences in these reports but together these studies confirm the flexibility of e-learning as a resource that can be accessed at anytime.

Access during class time (Replacement cohort)

The number of attempts made by the Replacement cohort during class teaching has been reported in half hour blocks to take into account the half hour rotations in the class (Figure 3.4).

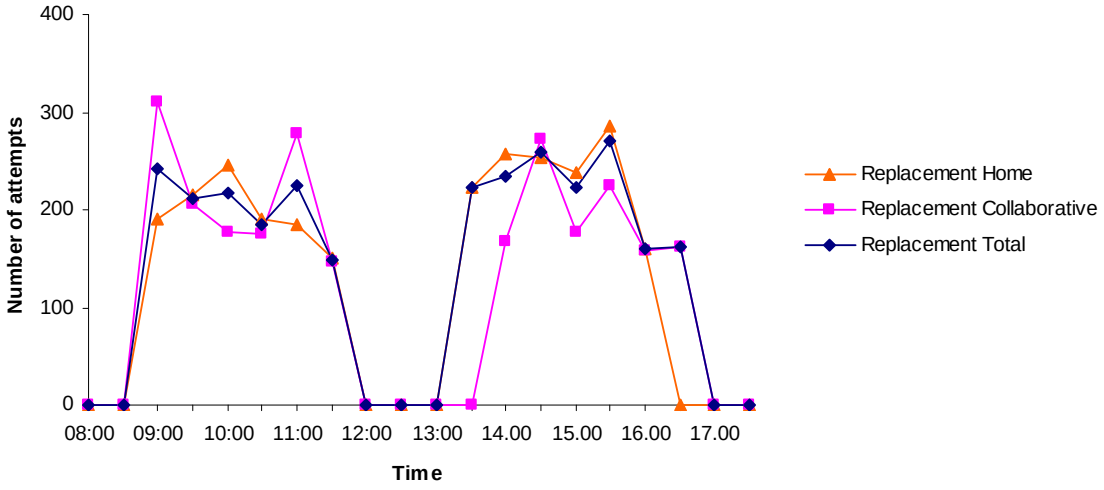

Figure 3.4 Access per 100 students in the Replacement cohort in relation to time of day: in class use only

The times of the afternoon classes were from 13.30 to 16.30 and 14.00 to 17.00 for the Home and Collaborative subgroups respectively. This explains the different shape of activity observed in the total cohort in the afternoon compared to the morning. The number of attempts were corrected to use per 100 students based on the number of students who had access to SCRIPT during each half hour period. Since only one subgroup had access to SCRIPT during the first and last half hour of the afternoon class, the use per 100 students for the total cohort was the same as the use of the subgroups who had access at these times.

There were more attempts per 100 students in the afternoon than in the morning for the Home subgroup: there were 1178 attempts per 100 students in the morning compared to 1418 in the afternoon. The reverse was true for the Collaborative subgroup, 1294 attempts per 100 students in the morning compared to 1161 in the afternoon. However, there is no clear reason for this finding. Another observation is

that the Collaborative subgroup demonstrated two peaks in activity in the morning between 9.00 – 9.30 and 11.00 – 11.30. Again there is no obvious reason for this finding because the students within each class started at the SCRIPT rotation at a different half hour period each week therefore these peaks were not due to particular groups of students. Khogali *et al,* (2011) suggest that the sequencing of e-learning opportunities in relation to traditional elements of a class may alter the way in which students utilise these resources. It is possible that the increased number of attempts during these time periods may have been in relation to particular class topics which prompted greater use of SCRIPT as a result of a previous rotation within the class. This requires further investigation.

Both Home and Collaborative students made fewer attempts per 100 students in the last half hour of the class. This might be an indication of student fatigue at this time of the class or due to a reduced need for SCRIPT as result of students obtaining knowledge from the taught stations by this point in time. It is not known from this data if staff had any influence on this finding. Qualitative methods may help elaborate on this from student and staff perceptions.

There are a number of potential weaknesses in the analysis of in class use. Firstly, students had to share computers in the class but the extent to which students had used SCRIPT in groups was not known, which means that each recorded attempt on SCRIPT may not represent access made by one student as suggested by the data. Secondly, a rolling average could not be applied because of the fixed times of the classes and there was an assumption that each rotation in the class had happened strictly on every half hour as scheduled. This may not have been the case in reality and the differences observed within each subgroup may reflect these rotations taking place earlier or later than planned. Thirdly, despite the number of students remaining consistent during each class, the students who were present in each morning or afternoon class may have changed from week to week. As such no statistical analysis was conducted and this report indicates a trend of student use in

class, which might not be representative of the actual class use. The topic of student use during practical classes merits further study, with more robust methods of data capture and analysis but is beyond the scope of this thesis.

Student use of SCRIPT in relation to the day of the week

Comparison of Supplemental and Replacement cohorts

The Supplemental cohort attempted SCRIPT a greater number of times than the Replacement cohort and this was statistically significant for all days (Mann Whitney *U* test, $p < 0.05$). Both cohorts displayed a similar trend of remote access in relation to the day of the week with the greatest number of remote attempts taking place on a Sunday, Monday, Tuesday or Wednesday (Figure 3.5). The access on these days compared to Thursday, Friday and Saturday was statistically significantly greater in both cohorts (Friedman's pairwise comparison, $p < 0.05$), highlighting a preference for pharmacy students to access SCRIPT early in the week, with a significant number of attempts on a Sunday, which suggests preparation for the week ahead. Howlett *et al,* (2009), reported that undergraduate medical students accessed a case e-learning programme most on Sundays, Mondays, and Tuesdays, which suggests similar access habits to the pharmacy students in this study.

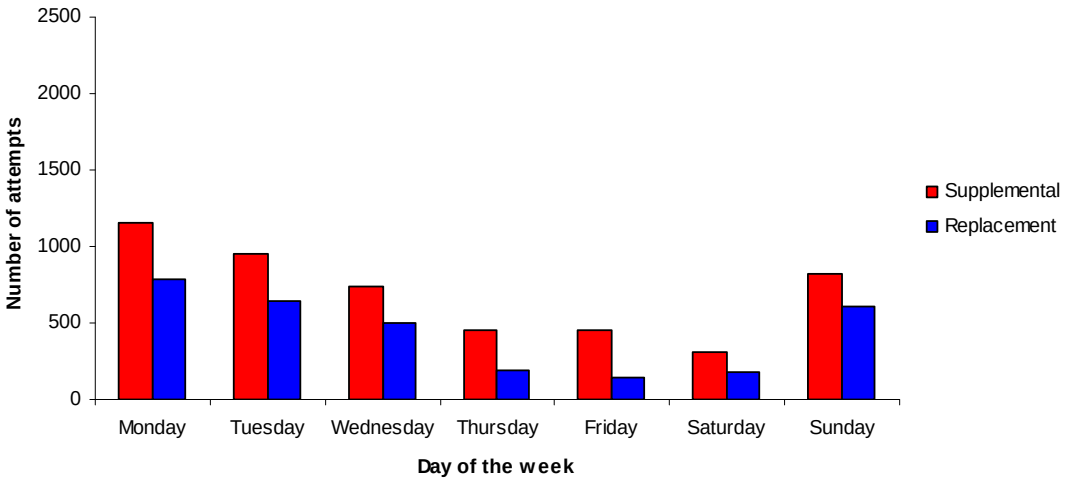

Figure 3.5 Remote SCRIPT access in relation to the day of the week, standardised to 100 students, for Supplemental and Replacement cohorts

Subgroup analysis

The Home students in the Supplemental and Replacement cohorts made greater use of SCRIPT at the beginning of the week and statistically significantly fewer attempts were made on Thursday, Friday or Saturday (Friedman's pairwise comparison, $p < 0.05$) (Figure 3.6). The Collaborative students in the Supplemental cohort made the greatest number of attempts on Wednesday, Thursday, Friday and Sunday, and the number of attempts made on these days was statistically significantly greater than on Monday or Saturday (Friedman's pairwise comparison, $p < 0.05$). In the Replacement year the Collaborative students demonstrated greatest access on Tuesday and Wednesday and this access was statistically significantly greater than on Thursday, Friday and Saturday (Friedman's pairwise comparison, $p < 0.05$).

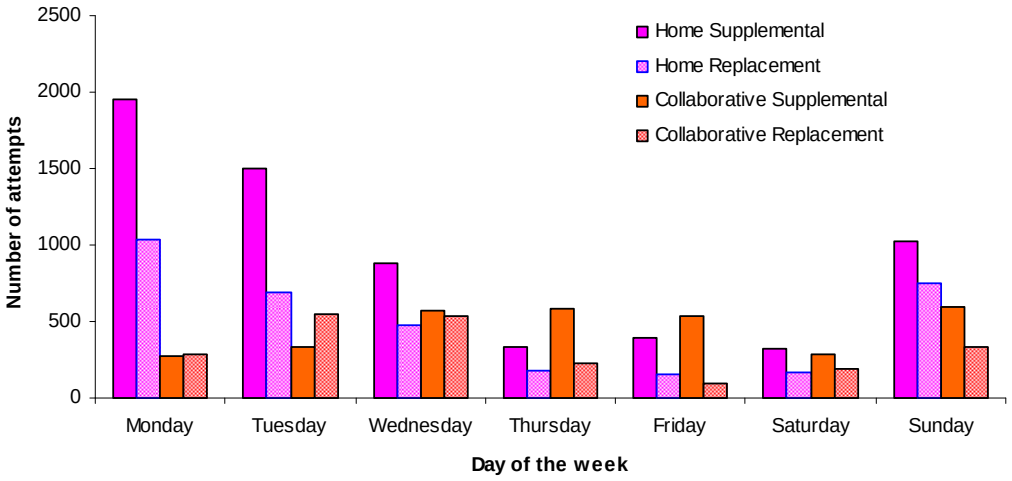

Figure 3.6 Remote SCRIPT access in relation to the day of the week, corrected to 100 students for Home and Collaborative subgroups

The Replacement model of integration appears to have changed the preferred day of accessing SCRIPT outwith class teaching for Collaborative students but not for the Home students. This may be a reflection of different days on which assessments

were taken, which differed between the Collaborative subgroups but less so between than the Home subgroups.

In both delivery formats the Home students had a preference for access at the beginning of the week, which fell as the week progressed. This may be explained by the fact that SCRIPT tests were released on a Monday and were available to all students, regardless of the day on which they were taught in class. As such some students may have accessed SCRIPT before their taught class this may have resulted in a reduced need to log in again later in the week. Sundays were popular in both years, but this was a day with no teaching and may be a common a day for revision or preparation for the next week.

Saturday was not a popular day for accessing SCRIPT for either cohort or subgroup, which correlates with findings from Tochel *et al,* (2011), who report similar findings in use of e-learning for postgraduate medical trainees. Other than choosing Saturday as a day of rest, employment may have influenced these findings. Pharmacy students are encouraged to find Saturday employment to complement their learning from class and increase future employment opportunities. However, not all students will have had employment and in addition this does not explain the similarities with medical trainees who do not generally work on Saturdays.

Access during class time

Although there is no comparable data for the Supplemental cohort, there were differences noticed in use made during class time when comparing the subgroups in the Replacement cohort (Figure 3.7).

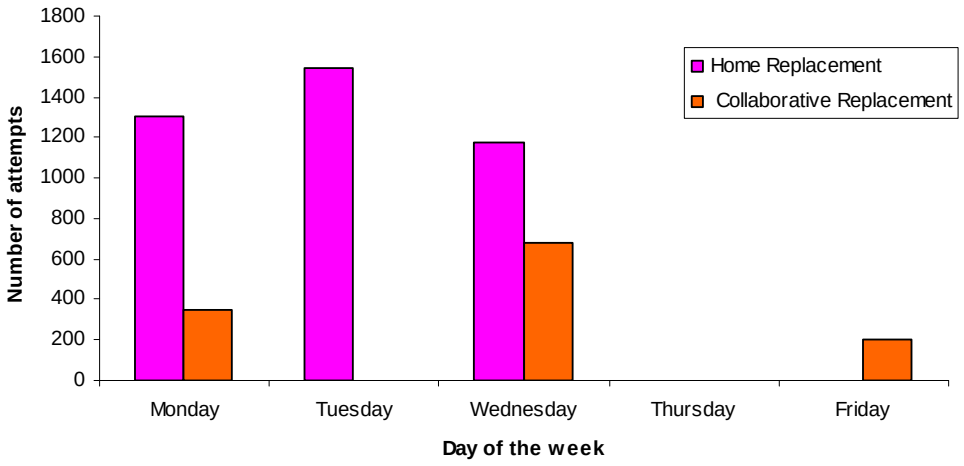

Figure 3.7 SCRIPT access during class teaching in relation to the day of the week, corrected to 100 students for the Replacement cohort

The Home subgroup accessed SCRIPT consistently on the three days on which it was available in class, with the greatest number of attempts on a Tuesday. Generally speaking, each student was allocated a specific class day and will have predominantly had access to SCRIPT in class on one day of the week only. As such these differences may be reflective of the class composition rather than a reflection of class topic or the day of week.

The Collaborative subgroup made more attempts on SCRIPT on a Wednesday than on Monday or Friday. In contrast to the Home subgroup all students in the Collaborative subgroup had access to SCRIPT in class on each of these days and the class topic was different on each day. As such the greater number of attempts on a Wednesday was because SCRIPT was available for four weeks on a Wednesday compared to only three weeks of teaching on a Monday and a Friday. In addition two of the topics taught on Wednesday were the most popular topics accessed in class time; Practise and Controlled Drugs 2.

Comparing the two subgroups, the Collaborative students accessed SCRIPT less than half the number of times that the Home subgroup did during class time, on all days

in which they had access. This finding may be representative of the fact that Home students attended one class each week whereas the Collaborative students attended three classes each week. As such the Home students may have perceived greater value in accessing SCRIPT after the longer time away from use in class. Perceived usefulness is a key driver for learner usage of e-learning resources (Sun *et al*, 2008; Wong *et al*, 2010) so this may have influenced the findings observed in this study. However, without knowledge of the group sizes relating to each login, it is difficult to draw firm conclusions. Student perceptions were investigated during qualitative interviews, but observational studies may be able to offer a further perspective in future research.

Student use of SCRIPT in relation to academic week / week equivalent

The student use of SCRIPT in relation to the academic week (for the Home students) or week equivalent (for the Collaborative students) highlights several peaks in activity throughout the year (Figures 3.8 and 3.9).

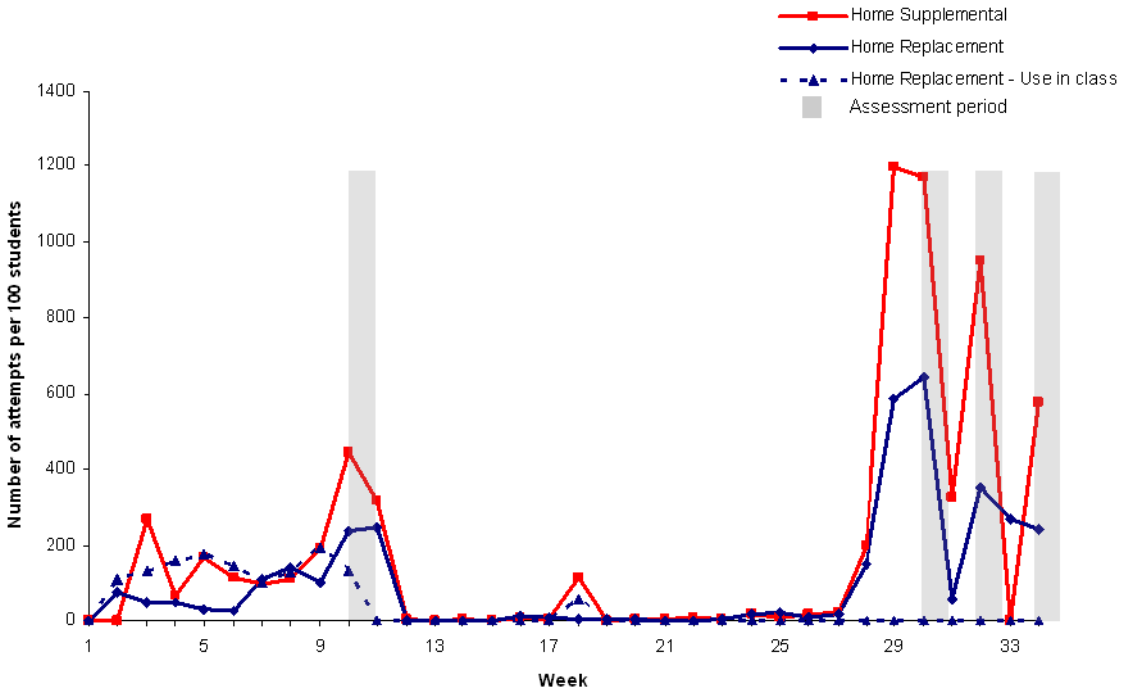

Figure 3.8 SCRIPT attempts each week, corrected to 100 students, for Home subgroups

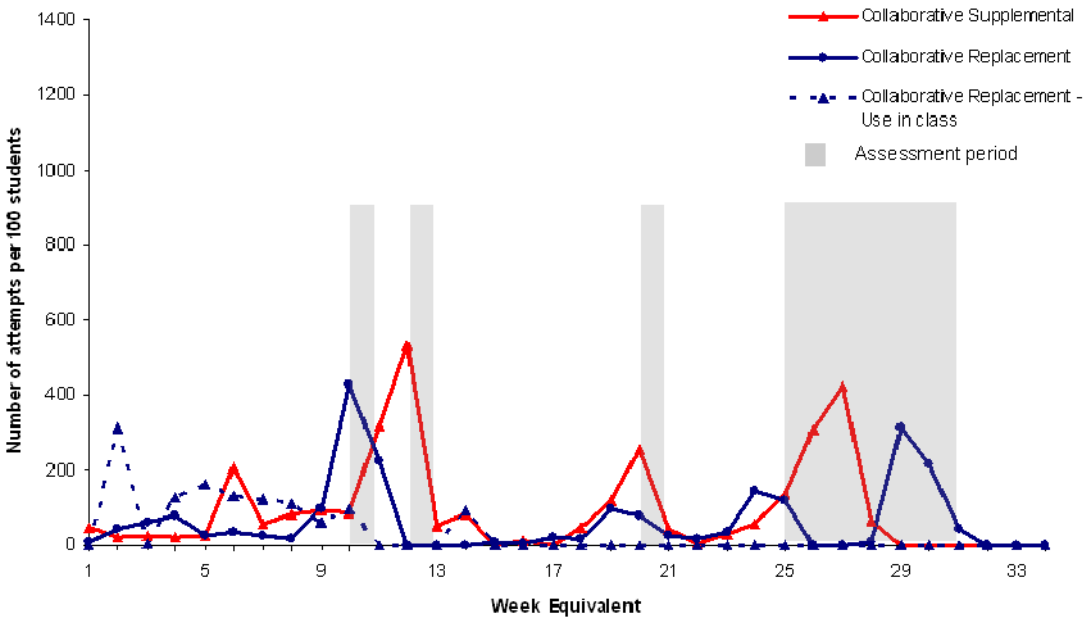

Figure 3.9 SCRIPT attempts each week, corrected to 100 students, for Collaborative subgroups

Home subgroups

In the Supplemental cohort the Home subgroup displayed a peak in activity at week 3, when SCRIPT was first released (Practise test), and then there was consistent access until the peak at week 10 which coincided with Class Assessment 1. The access noted at week 18 represents the release of the Interactions test which coincided with this taught class topic. There were three peaks in access at weeks 29 – 30, 32 and 34 which coincided with Class Assessment 2, the Exemption Assessment and the Degree Assessment, respectively (Figure 3.8).

There was a similar trend in activity for the Home subgroup in the Replacement cohort in terms of access outwith class teaching. Although there was no peak in use at week 3, when SCRIPT was made available, nor at the time of the release of the Interaction test at week 18. As with the Supplemental cohort the greatest access was noted between week 29 and 34 at the time of Class Assessment 2, the

Exemption Assessment and the Degree Assessment, which took place on week 30, 32, and 34 respectively (Figure 3.8).

In relation to SCRIPT use during class time there was consistent access recorded at the time of all taught classes: weeks 2 – 10 and week 18. This access may account for the differences observed between the cohorts for remote access during these weeks.

Collaborative subgroups

The Collaborative students in the Supplemental cohort made few attempts on SCRIPT until week equivalent 6. Compared to the Home students there were peaks in SCRIPT use to coincide with Class Assessment 1 at week equivalent 12, the release of the Interactions test at week equivalent 14, and at Class Assessment 2, the Exemption assessment and the Degree assessment at week equivalents 20, 26 – 28, respectively (Figure 3.9).

The delay in access until week equivalent 6 may be reflective of the fact that this was the Friday, Saturday and Sunday which followed the release of three popular topics, Controlled Drugs tests 1, Controlled Drugs test 2, and Paediatrics test, which were released on week equivalents 4, 5 and 6 respectively. Collaborative students may have seen these topics as important to their learning and used the weekend, where there were no classes, to catch up and consolidate the preceding week's work.

In the Replacement cohort the Collaborative students demonstrated greater use on week equivalents 2 – 4 than observed in the Supplemental year. As with the other subgroups there were peaks in activity around assessments on week equivalents 10, 20, 25 and 31. The greatest of these peaks was on week equivalent 10, coinciding with Class Assessment 1 (Figure 3.9).

As with the Home subgroup of the Replacement cohort, the Collaborative students made a consistent number of attempts between week equivalents 3 and 9 appears during class time. In addition, the use of SCRIPT at the time of the Interactions class appears to have occurred predominantly during class time (Figure 3.9).

Summary of use in relation to academic week

The Home students in both cohorts appeared to use SCRIPT as a revision tool, given that the majority of attempts made by these students occurred during the period that included Class Assessment 2, the Exemption Assessment and the Degree Assessment. This assessment period spanned five weeks, from week 29 to 34, and the number of attempts per 100 students made during this time decreased after each assessment. This may be indicative of retained knowledge from previous assessments.

Both cohorts of Collaborative students made more attempts on SCRIPT before Class Assessment 1 than the other assessments and there was little remote activity throughout the rest of the year. This may be explained by the nature of the Collaborative timetable in that there is little study time during the teaching period and hence students may have reserved use of SCRIPT for assessment preparation.

The number of attempts made before Class Assessment 2 in the Home subgroups was greater than at any other time of the year. This was not true for the Collaborative subgroups and this may be indicative of compressed teaching versus teaching over two semesters.

Compared to the Supplemental cohort, the Replacement cohort made fewer attempts on SCRIPT around the time of Class Assessment 2, the Exemption Assessment and Degree Assessment. Access before Class Assessment 1 was similar in both teaching formats. There are a number of factors which may have influenced this finding so it is not clear if the model of integration alone is responsible for this

observation. Since SCRIPT was optional, student motivation will have been depended on their individual choice to use SCRIPT as a revision aid. There is currently limited research into the effects of motivation on the success of e-learning (Cook, 2012).

Collaborative students in the Replacement cohort made more remote attempts on SCRIPT during the first 5 week equivalents than for the Supplemental cohort. This may suggest that the use of SCRIPT in class helped the Collaborative students gain familiarity with SCRIPT more quickly than in the Supplemental model, which may have been beneficial given the compressed teaching format of this subgroup. Freasier *et al*, (2003) report that a peak in the use of e-learning at the start of an academic year may be an indication of program familiarisation. In contrast, the Replacement cohort received a weekly timetabled session on SCRIPT with peer and staff support which may have resulted in greater familiarity with SCRIPT, thus leading to more efficient use in personal time. Alternatively some students in the Replacement cohort may have perceived less benefit in using SCRIPT for personal study if they had achieved their personal learning outcomes during class time or if they had decided that they disliked SCRIPT after their experience in class.

Given that all subgroups demonstrated greatest remote access at the time of assessments, it is worth considering the impact of assessment day and the finding from the study of use in relation to day of the week (Figure 3.6). Most of the assessments for Home students were scheduled at the beginning of the week (Table 3.6) which may explain the preference for access at this time of the week. The Collaborative students in the Supplemental cohort had assessments on all days, but three of the eight assessments were on a Friday. This may explain the greater use observed at the end of week for this subgroup. The Collaborative students in the Replacement cohort only had assessments on Mondays and Wednesdays which may help explain the greater number of attempts made during the middle of the

week. For this subgroup assessments were repeated on the same day which is why there are fewer days of assessments than for the other subgroups.

An increase in e-learning use immediately before assessments has been reported in other studies (Halls & Evans, 2006; Howlett *et al*, 2009; Hege *et al,* 2011). Hege *et al,* (2011) report that undergraduate medical students demonstrate a clear increase in e-learning use on the two days before and the day of assessments. This finding is similar to the pattern of access in relation to SCRIPT.

Table 3.6 The number of times each weekday was used as an assessment day in each cohort and subgroup

Cohort	Day of assessment				
	Monday	**Tuesday**	**Wednesday**	**Thursday**	**Friday**
Supplemental					
Home	2	3	2	1	0
Collaborative	2	1	1	1	3
Replacement					
Home	3	3	3	0	0
Collaborative	2	0	2	0	0

Student access to individual tests

Remote access over the academic year

The top four tests accessed, outwith class teaching, were the same for both cohorts: the Revision test, Controlled Drugs 1 test, Controlled Drugs 2 test and the Practise test. Students in all subgroups accessed the Revision test and Controlled Drugs 1 test in preference to the other tests. The Practise test was the third most accessed test in the Supplemental year, for both subgroups, and the Controlled Drugs 2 test was the third most accessed test in the Replacement year for both subgroups. The Home students made more attempts at all tests compared to the Collaborative students in both cohorts. This analysis reveals that students used SCRIPT to revise specific topics regardless of whether the Supplemental or Replacement model was adopted. This was true for both Home and Collaborative students.

It is clear both cohorts made more use of the revision test than any other test. This highlights the role of SCRIPT as a revision tool and indicates that integrating SCRIPT into class teaching does not remove this focus from the students. The Replacement cohort made less use of the Practise test than the Supplemental cohort, which may be indicative of the test name. Recent literature highlights that students' ability to use an e-learning resource can influence their acceptance of that resource (Wong *et al,* 2010; Moule *et al*, 2010), so the Supplemental cohort may have seen a benefit in using the Practise test in their personal time to ensure that they were familiar with the technology before they could use it as an effective resource for revision. The Replacement cohort had designated time during class teaching to become familiar with SCRIPT with the Practise test. This cohort could seek guidance from teaching staff during this time, which may have reduced their need to use this test in their own time.

Student access in relation to test release dates

Remote access in the Supplemental and Replacement cohorts

The percentage of SCRIPT attempts that were made on the test of the week, the test that was aligned to the taught material of each week's practical class, was calculated to compare the way in which each cohort of students targeted tests in their own time (Figure 3.10).

For this section of the study the term "week" will be used to represent both the academic week (Home students) and week equivalent (Collaborative students).

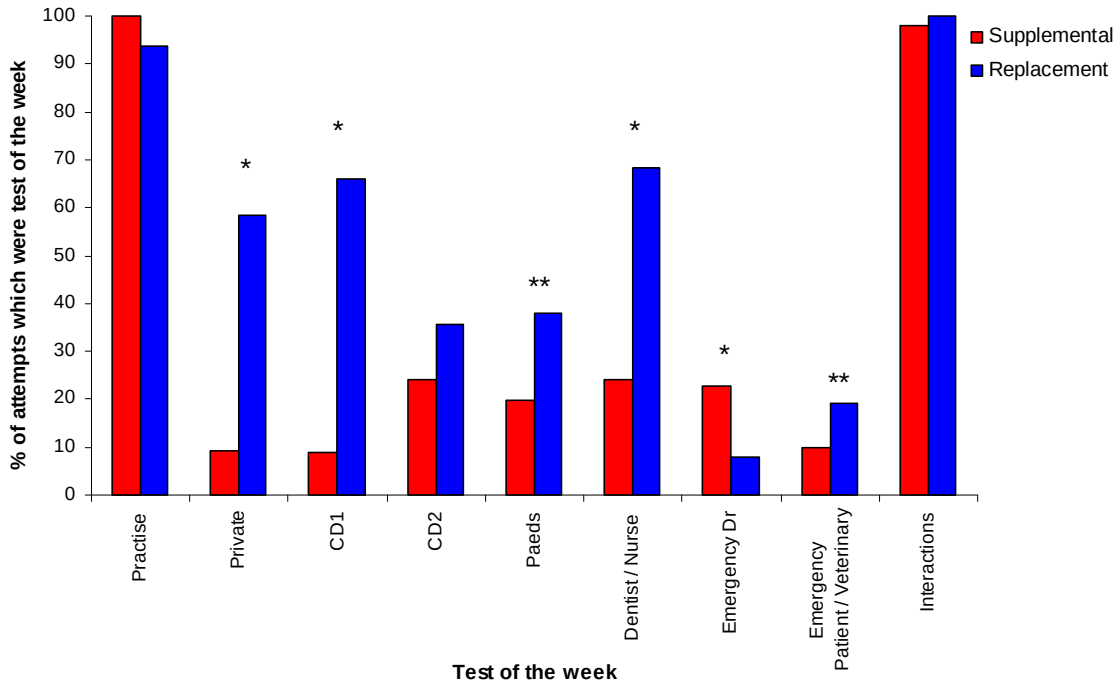

Figure 3.10 The percentage of remote attempts made on each week that were test of the week in the Supplemental and Replacement years.

* Statistically significantly different, Chi square two tailed ($p < 0.01$)

** Statistically significantly different, Chi square two tailed ($p < 0.05$)

In both the Supplemental and Replacement cohorts the greatest percentage of attempts made for the test of the week were on the Practise test and Interaction test weeks. This finding is logical because the Practise test was the only test available on the week in which it was released. Some Collaborative students in the Replacement cohort had accessed the Revision test through the Home students' class code on SPIDER, which explains the difference between the cohorts. The Interactions test was the only test released in the second semester and at a time when SCRIPT was rarely being used for revision, so students may have logged in as a response to the availability of new material or to consolidate learning from this class.

The Replacement cohort displayed a trend for greater targeting of the test of the week than the Supplemental cohort. A Chi test (two tailed) revealed that the

Replacement cohort made a statistically significant greater proportion of attempts on the test of the week during the Private week (χ^2 = 147: p < 0.01), the Controlled Drugs 1 week (χ^2 = 76.64: p < 0.01), the Paediatrics week (χ^2 = 5.19: p < 0.05), the Emergency Patient and Veterinary week (χ^2 = 10.89: p < 0.05) and the Dentist / Nurse week (χ^2 = 74.6: p < 0.01) compared to the Supplemental cohort. However, during the weeks of the Emergency Doctor test and the Emergency Patient and Veterinary tests, the Replacement cohort demonstrated a very low percentage of attempts at the test of the week compared to the other weeks. The Supplemental cohort made a statistically significant greater proportion of attempts on the test of the week during the Emergency Doctor week (χ^2 = 19.37: p < 0.01) compared to the Replacement cohort. This may be due to students in the Replacement cohort making an increased number of attempts at the Controlled Drugs 1 and Controlled Drugs 2 tests, presumably in preparation for the Class Assessment 1.

Overall, this pattern of activity suggests that the inclusion of SCRIPT during class teaching affects the way in which students target their use of SCRIPT outwith the class. Other studies have reported clear differences in the uptake of e-learning based on the voluntary or compulsory nature of a resource (Hege *et al*, 2011) and the alignment of a resource to key components of a class (Tochel *et al,* 2010; Hege *et al,* 2011). This study adds to the information available on how student use of e-learning may differ with different integration approaches but there is still a need for further research into this area to determine what integration approach is most appropriate to achieve particular learning outcomes (Cook, 2010).

In class access in the Replacement year

During class teaching the Replacement cohort demonstrated a high level of targeting of SCRIPT scenarios that were aligned to the topic of the week (Figure 3.11). This was true for both Home and Collaborative students.

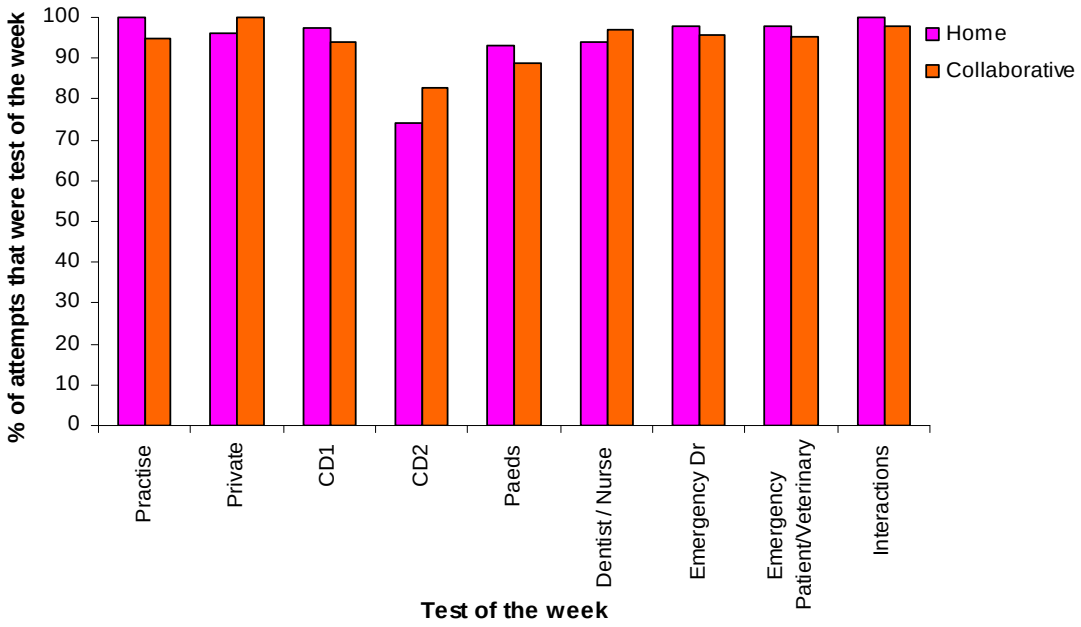

Figure 3.11 The percentage of attempts made on each week that were test of the week in the Replacement year

The only week during which the percentage of attempts made on the test of the week fell below 90% was the Controlled Drugs 2 week; this was true for both subgroups. Further analysis of scenarios accessed in this week revealed that several students accessed the Controlled Drugs 1 test in addition to the Controlled Drugs 2 test. This finding may be explained by the fact that the prescription scenarios included in Controlled Drugs 2 test were more challenging than the scenarios of the Controlled Drugs 1 test so students may have revisited the Controlled Drugs 1 test to refresh their knowledge or to address gaps in their knowledge when faced with the more challenging scenarios. This is reassuring because it indicates that the students had evaluated their own learning needs and had taken action to address these. These are keys skills for self directed learning (Fry *et al*, 2003) and indicate that the students in this study were motivated to learn on their own (Knowles *et al,* 1998).

Overall, both subgroups targeted the test of the week during class time to a greater extent than was observed during remote use of SCRIPT in the same week. This might be because students saw a direct benefit from accessing the test of the week in class because it complimented the tutor led scenarios. The novelty of a new selection of scenarios may also have led to this observation. However, this assumption presumes that students were motivated by andragogical principles (Knowles *et al*, 1998), which may not have been true. Students may have accessed the aligned scenarios because they thought that they were supposed to or because staff circulating in the lab may have directed students to these scenarios. Qualitative methods may be able to explain why students chose to use SCRIPT in this manner.

3.6.3 The relationship between SCRIPT use and the pass rate for competency based class for the Supplemental and Replacement cohorts

There were 241 and 217 students who sat the Exemption Assessment and 169 and 140 students who sat the Degree Assessment, in the Supplemental and Replacement cohorts respectively. Fewer students sat the Degree Assessment due to a number of students gaining exemption from the Exemption Assessment and there was one person absent from the Degree Assessment in both cohorts. A Chi square revealed that there was no statistical difference between the cohorts for the proportion of students who passed the Exemption Assessment ($\chi^2 = 1.621$: $0.5 > p > 0.10$) and the Degree Assessment ($\chi^2 = 0.162$: $p > 0.5$).

In a large meta-analysis of the effectiveness of e-learning in Healthcare professionals Cook *et al* (2008) reported that e-learning can offer alternative educational formats without negatively impacting on learning outcomes when compared to traditional teaching models. However, Cook (2009) also highlights that more research is needed to compare e-learning with e-learning to determine when and how to use technology in the most effective manner.

In this study, two models of integration have been compared, and this result indicates that adopting a Replacement model of integration did not affect the students' ability to pass the competency based class, compared to a Supplemental model. Thus SCRIPT provides an additional teaching option which reduced the staffing requirements by one member for each lab but did not have a negative affect on achievement of the competencies required to pass the class assessment. The Replacement model allows students the option to explore individual and group use of SCRIPT in a supportive lab environment: this option appears to alter the cohorts' use of SCRIPT but does not appear to affect achievement in the class.

3.6.4 Summary of findings from the quantitative analysis

The quantitative analysis has identified that students accessed SCRIPT predominantly in their own time, and in the lead up to class assessments, which is consistent with current literature (Hall & Evans, 2006; Howlett *et al*, 2009; Perceval & Muirhead, 2009; and Tochel *et al*, 2011). The majority of attempts occurred during the day and evening, with fewest attempts during the night. Saturdays were not a popular day for accessing SCRIPT and the day of the week on which SCRIPT was accessed, which is consistent with current literature may have been linked to the day on which class assessments took place (Hall & Evans, 2006; Perceval & Muirhead, 2009; Tochel *et al*, 2011). Allowing students access to SCRIPT during class teaching appears to have reduced the number of attempts made but students in the Replacement cohort appeared to target the test of the week to a greater extent than the Supplemental cohort. Qualitative methods may help explain the reasons for these findings.

A number of differences between the Home and Collaborative subgroups, in both cohorts, were noted in this study. As such, cultural differences between the subgroups may have influenced the student use of SCRIPT. Tapanes *et al*, (2009) suggest that one of the most frequently cited dimensions of cultural values in relation to student perceptions of online learning is the individualist/collectivist

dimension. This is a continuum where cultural values are either predominantly individualist or collectivist. Individualist cultures encourage outspoken thoughts and people in these cultures are comfortable with the risk of confrontation arising from opposing points of view. In contrast, collectivist cultures value agreement with a group perspective. As such, collectivists are less likely to speak up unless permitted but the group or if requested by an instructor. In addition, collectivist cultures may have a preference to learn through excessive, rote practice rather than through evaluative learning that is seen in instructivist cultures.

In relation to this study, students in the Home subgroup, who were predominantly from the UK, are likely have individualist values and the Collaborative students, who were from Malaysia may have had cultural values similar to those from Chinese/Indian cultures, which tend to be collectivist in nature (Tapanes *et al*, 2009). This could have influenced SCRIPT use both in and out with class. Although speculation can be made on how these values may have influenced the learning process adopted by each subgroup more data is required to draw firm conclusions.

Another consideration is that individual students may have had different learning preferences, which could account for some of the differences observed between and within subgroups. Cognitive and learning styles have been a focus of e-learning research for a number of years (Cook, 2005; Cook, 2012). The variety of preferences within each subgroup has not been determined, nor has the effect of learning preference on SCRIPT use. A recent review (Cook, 2012) suggests that adapting e-learning to meet individual learners' styles is difficult due to the lack of reliable instruments for assessing learning styles and may be cost ineffective because the benefits may be minimal compared to ensuring good instruction design principles are adopted. However, the author suggests that one option may be to offer the learner the choice to use an approach that suits their needs may be a suitable way to address differing learner needs. The Supplemental and Replacement models of SCRIPT allow for this which means that learning styles may be one of the reasons for

the observed differences, however, this cannot be determined by quantitative methods alone and perhaps qualitative research, including observational studies in a larger ethnographic approach, may offer more insight into this area.

3.6.5 Student and staff perceptions of SCRIPT as a Supplemental and a Replacement program.

3.6.5.1 Student perceptions

Demographics

Twenty final year students from the Replacement cohort were interviewed to obtain their perceptions on the use of SCRIPT during class time and remotely for personal study. There was representation from all subgroups and a mixture of students who did and did not have previous experience of working in a community pharmacy (Table 3.7).

Table 3.7 Demographics of students interviewed for their perspective of SCRIPT

	Home	Home 2+2	Collaborative	Total
Number of students interviewed	10	8	2	20
Number of students with community pharmacy experience	10	4	0	14

The initial coding of the transcripts identified 143 codes which were then aligned to seven overarching themes (Table 3.8) describing the students' experiences of using SCRIPT.

Table 3.8 Themes of student perceptions of their use of SCRIPT

Theme	Theme title
1	Use of SCRIPT during class time
2	Sources of help available to students using SCRIPT during class
3	Use of SCRIPT in personal time (remote use of SCRIPT)
4	Anticipated use of SCRIPT if it was not available in class time (the Supplemental model)
5	SCRIPT in general
6	Community pharmacy experience
7	Suggested changes to SCRIPT

Theme 1 – Use of SCRIPT during class time

All students commented that during class time they had targeted the scenarios that were aligned to the class teaching. Some students indicated that they were instructed to target the aligned scenarios, "*we got assigned tasks to do*" (S4.Home), where as other students indicated that they had chosen this approach because they found it easier to learn one topic at a time.

The majority of students accessed SCRIPT in pairs with some students working through scenarios together and others taking turnabout, "*I done the five that were in the wee section and [my partner] did her five*" (S11.Home). Some students indicated that they had logged out of their account so that their partner could log in for their turn, *"we finish like from my account…and then we switch to her account*" (S2.Home2+2). This is an important consideration for analysing logon data to determine quantitative access in class. Some students chose to log in as small groups of unspecified size and composition. During the quantitative analysis each log created by each attempt at SCRIPT may have equated to more than one active participant due to computer sharing. However, even when sharing access some students may have logged in and out of their accounts, which would be reported as different users accessing SCRIPT. Others may have logged in as one user and refreshed the screen to obtain new scenarios, which would have been reported as one user making numerous attempts. Also it is not clear if all students who were viewing the screen were participating actively in the decision making or if some

were simply observing. This indicates the potential for inaccuracy when using logon files to draw firm conclusions about SCRIPT use in class time. Although group size can be estimated, the actual activity and participation of each group member cannot be determined from the usage data alone. What is known from this study is that student use within class time differed from student to student, but the extent and the impact this has on learning has yet to be determined.

The majority of students indicated that working in pairs was beneficial because "*it was easier to discuss with each other what you thought rather than just doing it yourself*" (S3.Home) and it helped clarify misunderstandings "*some of the answers were a bit…ambiguous so if you'd two people then you could kind of work through them a bit better*" (S9.Home), "*I [used SCRIPT] with another [student] and we might discuss the answers before we submit and if there were any mistakes we just discuss why and what went wrong*" (S1.Collaborative).

Some students who had accessed SCRIPT alone commented that they would have preferred to work in pairs or groups because of the opportunity to discuss scenarios. It was not clear why these students had not worked in groups but this may be a result of incompatibility with students in the same group as suggested by those who reported negative experiences of group working, "*[group working was] infuriating 'cause some people were slower than you*" (S5.Home) and "*you have to wait for your partners to finish first so you don't have your own time to do it*" (S10.Home2+2). However these views were not shared by all students, "*if I was sitting with somebody who was a pal then we'd do it together*" (S5.Home), and the student's experience of using SCRIPT and their stage of development may have influenced this, "*for the first time I prefer to do it in pairs but afterwards I prefer [to] do it alone because I can learn alone than when I do it in pairs because my partner, she's really smart*" (S10.Home2+2).

A meta-analysis comparing the individual and group use of computers has demonstrated that students working as a group required less support from staff, obtained greater group task achievement and reported more student satisfaction compared to students who had worked alone. However students working individually used staff support and feedback in the program to complete their work more quickly (Lou, 2001). The student comments in this study support these perspectives and it might be worth considering the option to self select groups in the laboratory sessions to improve student satisfaction.

The majority of students attempted fewer than 10 scenarios in the 30 minute rotations of the taught class. All the students who attempted more than 10 scenarios were from the Home 2+2 subgroup which may indicate a difference in learning styles between the subgroups. This may also help explain why the number of attempts during class time was greater for the Home subgroup as a whole (Home and Home 2+2 students) compared to the Collaborative subgroup as reported in the quantitative analysis (Figure 3.7).

The majority of students used SCRIPT for less than the allocated 30 minutes, indicating that"*[the time available in class] could have been less and [we could have] maybe used our time for something else*" (S13.Home). However, there were opposing views as well, "*you hardly got any time to like finish it*" (S14.Home), and "*[the time available in class] was a good amount of time…you can't expect, like, to be given extra time just for slow people like me*" (S15.Home). This again suggests that different learning preferences or ability may have influenced how students used SCRIPT during class time.

The majority of students suggested that their use of SCRIPT in class had remained consistent throughout the year. Although some students thought their use had decreased over time, perhaps because SCRIPT was seen as a novelty at first. Other students indicated that SCRIPT became easier to use as they became familiar with it

and that this may have affected their access because they "*got better at picking what answer [SCRIPT] wanted*" (S11.Home). Access may also have changed as more examples became available. These findings suggest what is already known from recent literature, that the perceived usefulness and perceived ease of use of an e-learning resource can influence the extent to which students will use that resource (Sun *et al*, 2008).

Some students indicated a number of additional factors that they felt had influenced their use of SCRIPT in class, including: errors and ambiguity in the program, *"it's frustrating sometimes 'cause you use it and there's errors…it was actually more a problem with the, the program itself [rather] than students. And I think that kinda hacked a few people off and, so you just thought 'I'm no' going to bother doing it*" (S20.Home), the speed of the technology "*it was so slow moving*" (S5.Home), and the noise in the class, *"it's too noisy and stuff and it's too hard to take notes*" (S14.Home). These findings reflect the initial investment required to ensure that the content and technology are user friendly and reliable, but also that the environment is conducive to learning (Childs *et al*, 2005).

Some students suggested that they used SCRIPT to recap what they had learned from class notes, "*I'll just go through the notes in the [competency-based class] book and then after that I will use SCRIPT as a like a recap*" (S6.Home2+2), where as others were not motivated to use SCRIPT in class at all, "*I thought I can just do this at home*" (S20.Home). These two views appear to reflect one student who is self-directed and motivated to learn, as opposed to another who is disengaged. However, Lindeman's principles of adult learning (Knowles *et al,* 1998) indicate that both views are equally valid and perhaps the second comment reflects that fact that this student did not see the benefit in using SCRIPT but they have not rejected it entirely because they are aware that they can refer to it if required in the future. This also agrees with Davis's Technology Acceptance Model (Davis, 1989), which has been shown to be relevant in the context of e-learning resources (Sun *et al*, 2008).

Theme 2 – Source of help available to students using SCRIPT during class

The majority of students highlighted that staff were a good source of help during class time, indicating that they were *"more accessible [than other sources of help]*" (S1.Collaborative), and that consulting with staff was reassuring because "*quite often they were finding the same problems as we were*" (S3.Home) and because "*they really took time to explain[things] to us*" (S12.Collaborative).

Students who chose not to use staff as a source of help, stated that "*usually if you got something wrong you knew why it was wrong, it wasn't a total mystery*" (S20.Home) and "*it's really easy, I mean it's just a computer and some books*" (S8.Home2+2), indicating that the feedback on SCRIPT and other resources in the class were sufficient to support their learning. However, other comments suggest that some students did not want to ask staff for help without stating whether they would have benefited from this interaction or not, "*I just keep quiet…I don't feel like asking anything*" (S7.Home2+2).

Nearly all the students indicated that they viewed other students as a source of help, they had "*just questioned [the scenario] to one another because the, em, answers that the feedback gives you is quite comprehensive*" (S5.Home) and that "*you know from their own experience and listening from their own experience it's easier to understand rather than just staring at the screen of the computer.*" (S8.Collaborative). An example of learning from the experience of others is that the Home 2+2 subgroup found that talking to Home students was helpful because they could learn from the Home students' experience of community pharmacy. "*[The Home students] seem to be working in community and I think they've been doing the SCRIPT before and because they can manage to do it very fast*" (S18.Home2+2). These comments reflect constructivist and social models of learning, which current literature suggest should be the key model focus when designing e-learning (Bangert *et al*, 2004; Garrison & Kanuka, 2004).

None of the students who were interviewed had made use of the SCRIPT email helpline and the majority highlighted that they were not aware of it. Most of the Home subgroup would not have used the email had they known about it. Conversely several of the students from the Home 2+2 and Collaborative subgroups had suggested that they might have used it had they been aware of it. Some students indicated that the email helpline might have been more helpful for remote study than for support during class time.

> "*[I didn't use the email because] I didn't think it was that difficult to use*" (S9.Home)

> "*I felt [that SCRIPT] it was quite good, like, if you got a question wrong it would then tell you the answer and why you got it wrong and explain it, so I don't think you would really need the [email] helpline*." (S14 Home)

Although the helpline was not greatly used it is important that is remains in place because students should have a facility that they can use to make contact with academic staff, should they require further assistance (Cook & Dupras, 2004). The email helpline allows for this to happen regardless of the time at which a student logs into the program.

Approximately half of the students had used text based references as a source of help, including, the British National Formulary (BNF) (Joint Formulary Committee 2011), Medicines Ethics and Practice (MEP) (Royal Pharmaceutical Society of Great Britain, 2010) and Stockley's drug interactions (Stockley & Baxter, 2010). In particular, students from the Home 2+2 and Collaborative subgroups suggested using text based resources for help before suggesting staff or students. This may be due to cultural differences as these students may have collectivist values which would suggest that these students would be more comfortable working as a group rather than asking lecturers compared to the Home students who may be more

confident speaking up (Tapanes *et al,* 2005). Alternatively as Percival & Muirhead, (2009) highlight, textbooks can be commonly used resources simply because students feel comfortable with them based on past experiences.

Although there was variety in the students' opinions in this theme, one thing that was common was that students had access to their preferred source of help, whether that was staff, students, textbooks or the internet. Flexibility has been identified as a benefit of technology enhanced learning (McKimm, 2003) and this is clearly observed in the student's comments as they have control over their preferred resources. Garrison & Kunaka, (2004) state that in a blended learning environment "the emphasis must shift from assimilating information to constructing meaning and confirming understanding" through dialogue and debate. Garrison & Anderson, (2003) describe the social characteristics of this approach in the context of a Community of Inquiry, in which learning is dependent on social presence, cognitive presence and teaching presence. The teaching presence is key to the facilitation of learning and ensuring a conducive learning environment. Several of the students' comments display the advantages associated with a community of inquiry model but some comments implied negative aspects associated with this model as well. As one student described:

> "*[If SCRIPT was] your last station that week you got to like, go home early anyway…half an hour early, which sort of shows the staffs' opinions of how useful a half hour of SCRIPT was*." (S5.Home).

This student did not question whether staff were knowledgeable or approachable as a source of help, but questioned staff engagement with SCRIPT in general. Cook & Dupras, (2004) highlighted that securing "acceptance and commitment" from staff is essential to the successful uptake of e-learning programs. Greenhalgh (2001) even suggests offering rewards to staff who are active in using online technology. This study indicates the significance of staff buy in associated with e-learning because there is evidence that students' perception of an e-learning program may

be linked to how staff perceive the program. Child *et al,* (2005) report that it is important to consider a strategy to maximise staff support when planning to implement e-learning resources.

One reason for staff disengagement may be that some students chose to test staff knowledge, to "*argue problems [laughs]*" (S13.Home) by comparing their responses to the feedback on SCRIPT. Although this may be perceived as devious and could affect staff engagement this type of questioning will help students construct their own knowledge through a constructivist model of learning and staff should be accepting of this as their role should be to facilitate learning rather than to teach knowledge (Svinicki, 1999; Bangert, 2004). This is where the teaching presence of a community of inquiry becomes important, which should lead to a climate of supportive learning where staff and students are comfortable to share their knowledge and weaknesses so that everyone learns during the use of SCRIPT rather than fixating about errors or ambiguity in the program. Staff education on the content and functionality of SCRIPT may help achieve this as staff would be pivotal in facilitating this type of learning.

The comment above also highlights the difference between the traditional class format and the SCRIPT rotation in terms of pedagogical teaching versus andragogical learning (Knowles *et al,* 1998). If a student chooses to leave early, what would be the benefit in forcing them to stay for self directed learning? Given that e-learning should be learner centric (Childs *et al*, 2005), educating staff on becoming "facilitators of learning" rather than "teachers" (Knowles *et al*, 1998; Svinicki, 1999; Bangert *et al*, 2004) is as important encouraging acceptance in the use of technology alone.

Theme 3 – Use of SCRIPT in personal time (remote use of SCRIPT)

The majority of students indicated that they had used SCRIPT in their own time, at home, alone and predominantly for exam preparation. This supports the hypothesis from the quantitative analysis of user access data.

> "*[My remote use of SCRIPT] was more or less towards the end, like before the [competency based class] exam. I just kept on doing [the scenarios] over and over again to make sure I knew them*." (S14.Home)

> "*I mostly, um, practiced like one or two weeks before the [competency based class] exam, um, because I think SCRIPT is really useful for calculation questions, especially CD drugs and um like legality questions on the other types, yeah*" (S2.Home2+2)

Some students indicated that they used SCRIPT in preparation for or consolidation of learning from the taught class, "*usually it will be like one day before the [competency based class] lab… it definitely helps a lot like makes things clearer*" (S7.Home2+2), "*I'd obviously look at course notes during the day and then like try and see if I've learnt stuff by using that at night*" (S13.Home). This may account for some of the attempts on SCRIPT that observed at the beginning of the week, given that Home students had their taught class on Mondays, Tuesdays and Wednesdays. However, as indicated in the quantitative study, this is not the sole reason for the trend that students made most access at the beginning of the week because the majority of attempts in all subgroups were made around the time of class assessments. These comments do, however, suggest that some students used SCRIPT for learning in addition to revision.

Students indicated that they chose to access SCRIPT alone "*because it was faster*." (S2.Home2+2) and because it was easily accessible, "*I have my own laptop so I can just do it alone*" (S19.Home2+2). Some students perceived the need to "co-ordinate diaries" as a barrier to using SCRIPT in pairs or groups, which is contrary to some

students who did describe a group approach to using SCRIPT, "*two or three of us who gathered round a big screen in the library [because] we could all discuss what we thought was wrong and get pointers*" (S5.Home) which was particularly helpful for "*certain ones that you kept getting wrong answers*" (S16.Home).

Nearly half the students indicated that they had used SCRIPT in the evening and at night time because "*it'd be the last thing I'd do just to like revise*." (S13.Home), "*if I couldn't sleep I just do SCRIPT*." (S10.Home2+2), and*"[I accessed SCRIPT] at night like after dinner time so [that] I have some time to access it*" (S7.Home2+2). Other students indicated that their use of SCRIPT had varied and was limited to available free time, which may help explain the use observed in the evening and at night in the quantitative study. These comments suggest that students chose this approach because SCRIPT was easily accessible, it allows students to test what they have learned from their revision, and that night time is convenient because students can take as long as they require to complete the scenarios.

A few students did not use SCRIPT in their own time because, they did not agree with the answers, "*I didn't think it was very helpful. Eh, some of the answers in it when you put them in, it came up as wrong*" (S9.Home), or because they had had enough benefit from use in class, or that they did not have time due to the compressed nature of summer teaching, "*actually I haven't used it outside the lab, because we actually have three [competency based class] labs in a week so that was really very hectic*" (S12.Collaborative). The first two of these statements support the work of Sun *et al,* (2008), who reported that e-learning course quality and the perceived usefulness of e-learning were two of seven key factors that influence learner satisfaction.

The interviews revealed four approaches that students had adopted to target prescription scenarios (Table 3.9). The most common approach, which was mentioned by approximately half the students, was to target prescription types

related to perceived weaknesses. This is reassuring because it indicates that students were able to reflect on their own knowledge and prioritise accordingly. This suggests that students are learning in line with the principles of adult learning as they are in control of determining what they need to know and how this will be achieved (Knowles *et al,* 1998). In a recent study into the use of e-learning by medical students, Khogali *et al,* (2011) report that some students adopted a systematic approach to accessing the resources compared to others who "preferred to browse". The authors suggest that student use varied depending on learning preference and the perceived value of the e-learning resource which may be influenced by the sequencing of the release of the resource relative to other elements of the curriculum.

Table 3.9: Approaches for targeting prescription scenarios in SCRIPT

Approach	Approach description	Sample quotation
1. Targeting weaknesses	Students targeted prescription types based on their perceived weaknesses	"*I'd do the revision tests usually for [the competency based class] and what I considered I was weakest at myself as well…for example like I was always doing controlled drug ones to get them like, nail them and stuff like that but, em, in the main just the revision tests*" (S5.Home)
2. Random	Students attempted random prescription types to test knowledge	"*Well I will just randomly pick… or I'll just do one of each, one set of each topic*" (S19.Home2+2)
3. Linear	Students progressed through the scenarios in a linear fashion based on order of topic release date	"*I think I just whatever one was at the top I did first, whatever one was at the bottom I did last*" (S13.Home)
4. Targeting topic	Student accessed prescription types based on the topic which they were revising at the time – to consolidate learning	"*If I was studying a section I'd then go and do like the scripts on that and…worked my way through them*" (S14.Home)

This study highlights that the student use of SCRIPT in their own time was varied and user access data cannot predict the true intention of students, "*I actually used it more than I thought I would, outside of classes. I used it…in the run up to the exams in particular; I used it a fair bit. And then…I used it kinda on and off throughout the term, if I had half an hour or something.*" (S20.Home) nor to describe what the student actually does when logged into SCRIPT, "*[at home] you play your Facebook while doing your SCRIPT so you know you're not really focusing on that so.*" (S10.Home2+2).

Theme 4 – Anticipated use of SCRIPT if it was not available in class time (the Supplemental model)

The majority of students thought that their use of SCRIPT would have been less had it only been available for remote use. The reasons that students gave for this were that they would have been less familiar with SCRIPT, *"if they didn't tell us what to do in class I probably wouldn't have known about SCRIPT*" (S17.Home2+2), they would have been less motivated to use it if it was not compulsory, "*it would be sort of maybe one of the things I maybe wouldn't have got round to*" (S11.Home) and they would have found SCRIPT less useful for their learning, "*not so much as useful as using in the lab due to the lack of help from supervisors*" (S12.Collaborative) and "*I might not see it as such a good revision tool for the class tests if you're not using it in the class*" (S5.Home).

There were some suggestions on how SCRIPT use might have been different had SCRIPT not been a part of class teaching: *"I probably would have just used it for like the big [competency based] exam at the end*" (S13.Home), "*maybe once I had done the lab I'd maybe go home if I had time and then look over it then, em. Cos I do think it did help like doing it through the lab cos you actually got to test yourself on what you were learning.*" (S14.Home), "*I might have spent more than 30 minutes…if I do it outside the lab I can do it like more, more when I want*" (S6.Home2+2). There were also suggestions that students would use different sources of help for their remote use of SCRIPT had it not been available in class, "*that might be where I could use that email helpline*." (S15.Home), "*I think I would work together with my friends*" (S18.Home2+2).

Although these findings cannot describe what students would actually do if the Supplemental model was adopted, they highlight what students thought of the Replacement model. Students appreciated the introduction to SCRIPT and the use of SCRIPT in class because it was helpful in testing their knowledge and understanding and they believed that they would make more use of SCRIPT in a

Replacement format than a Supplemental format. This is a similar finding to another study in which the authors suggest that e-learning resources should be implemented in a traditional format, like the in-class use of the Replacement year, before offering them as a distance only option, as in the Supplemental year, to improve learner familiarity (Pituch & Lee, 2006). However the results from the quantitative analysis suggest that the students' anticipated use of SCRIPT may not be a reliable indicator of actual use given that the Supplemental cohort made more attempts on SCRIPT than the Replacement cohort.

Theme 5 – SCRIPT in general

The majority of students thought that SCRIPT was a good resource and that is was helpful for studying the competency based class. However, several students, including the majority of the Home subgroup, thought that SCRIPT was confusing and/or ambiguous. Some students thought that there were errors in the answers and feedback.

There were a number of positive and negative comments which have been summarised and highlighted by a selection of quotes (Table 3.10 and 3.11). Many of the positive aspects were mirrored by contrasting negative aspects which may be indicative of different learning styles of students in this study. This signifies the difficulty in achieving global acceptance of an educational program and suggests that e-learning may be a suitable resource for some students but not for others.

Table 3.10 Positive aspects of SCRIPT from a student perspective

Positive aspects of SCRIPT	Illustrative Quotes
There were lots of examples to work through	"*[SCRIPT was] good cause it gave you like loads of examples rather than just like the few we had in the book*" (S3.Home)
There was confidence in the program	"*I think it's a really valuable eh learning aid…there's a huge number of scripts and stuff on there … it's very easy to use, it's very user-friendly its interface and stuff, so, I think [short pause] it is a great system*" (S20.Home)
There was no requirement for staff to be present	"*it's pretty good, 'cause you don't need a lecturer there*" (S15.Home)
Scenarios were a realistic representation of the practical examples	"*It's kinda like…it's like sitting a past paper*" (S11.Home)
The feedback was a good	*"[the] feedback it gives you is really good because even if you have no idea, and just click submit it tells you like the right answer and why it's the right answer*" (S5.Home)
It was helpful preparing for the competency based class assessment	"*It's quite good that you can check things …otherwise there's no way you could actually like really practice for the [competency based] exam*" S13.Home)
	"*even working in community pharmacy…you're just so busy you don't really look at scripts and you don't look for errors and stuff… [SCRIPT is] a perfect way to practice it 'cause it's so easy*" (S20.Home)
It was good for familiarising students with UK prescriptions	"*I think it gave us exposure to prescriptions, like unless you have experience in a community pharmacy or something I would never have seen how NHS prescriptions look like*" (S17.Collaborative)

Table 3.11 Negative aspects of SCRIPT from a student perspective

Negative aspects of SCRIPT	
There was ambiguity/errors in the answers and feedback	"*Well some of the answers were, well I would think they were wrong, but em it might just have been the way they were worded*" (S9.Home)
	"*sometimes there were mistakes [laughs] yeah about the answers and stuff which confused us at times*" (S19.Home2+2)
There were not enough examples,	"*we should have more questions and it's quite sometimes the questions are repetitive for some part of the scripts*" (S18.Home2+2)
It required staff to be present to clarify answers	"*[For some] errors you have to consult the lecturers so you need like second help on that*" (S10.Home2+2)
The examples are not realistic enough,	"*like I suppose some of them were really, really far-fetched…you'd never see that in, like, real life*" (S13.Home)

There were two contrasting points of view that are worth highlighting given the nature of SCRIPT as a simulation program. One point of view was that SCRIPT was not realistic enough in terms of both layout and content: "*You'd never see that in, like, real life*" (S13.Home). Whereas an opposing point of view was that SCRIPT was a very good simulation of the practical class, "*it was the most practical thing you could do for [the competency class]. It was the most like our actual labs*" (S16.Home).

It is important to distinguish between these points of view because SCRIPT was originally designed as a study aid for students who were preparing for competency based class assessments. The use of SCRIPT has evolved and it was recently used for familiarisation with prescriptions and as a teaching tool in the competency based class. It was therefore a simulation of the competency class prescriptions and not

necessarily a simulation of real life pharmacy practice. Dror *et al* (2011) suggest that increasing the fidelity of an e-learning program may make a program true to life, but may also damage learning by increasing the cognitive load experienced by the learner. However, altering programs so that they are distorted from reality can actually improve learning because the key learning points become more apparent than they would in real life. Thus, SCRIPT may benefit from resembling, as opposed to replicating real life because students experience scenarios that signify key things that they need to learn.

Theme 6 – Community pharmacy experience

There was no consensus about whether community pharmacy experience had influenced the students' use of SCRIPT. Some students suggested that SCRIPT use was directly linked to community pharmacy experience "*[If I had less community pharmacy experience] I probably would have used [SCRIPT] less, em, to be honest…I saw it as something to build on, not to change.*" (S5.Home). Conversely a number of students thought that there was less of a need to use SCRIPT if a student had gained experience in community pharmacy, "*you'd find it much more helpful if you didn't work in a community pharmacy*" (S13.Home), "*if I had more community pharmacy experience maybe I won't need to, um, spend so much time on practising online because I had other ways to practice*" (S2.Home2+2).

These comments may reflect the students' perception of SCRIPT as either a program to enhance and consolidate learning from practice or alternatively as a replacement for the practical experience itself. However, regardless of how SCRIPT has been used or perceived, it is clear that the students who made these comments were outcome focussed and demonstrating self reflection to assess whether SCRIPT use would be helpful for their development.

Some students did not know or were not clear if there was a connection between SCRIPT use and community pharmacy experience with one student commenting

that with community experience they "*would have gotten through it quicker, but …would have used it the same amount"* (S15.Home).

Some students thought that there was little connection between SCRIPT use and community experience, perhaps because SCRIPT was more relevant to the competency based class and that real life practice was not the same as practice in the class.

> "*In pharmacy you don't really think about interactions and all the legal aspects of like CD prescriptions. So I think in that way [SCRIPT] was really beneficial and I don't think it really matters how many years' experience you've had.*" (S14.Home)

> "*It's mainly the pharmacist that [checks the prescriptions] so a lot of the time you're just out on the counter and stuff… you're not really looking at them, you're just passing them through so, I think SCRIPT tutor has the benefit that it helps you look at stuff in detail and examine it, whereas I don't think, community pharmacy does that so I don't think there is a huge link between the two…but everyone's community pharmacy experience is so different I think*." (S20.Home)

Again these comments are linked to how the students perceived SCRIPT. It appears that some of the students consider SCRIPT to be a simulation of real practice as opposed to a simulation of the examples in the class. As SCRIPT has been integrated into teaching it is now used to help students develop the skills of prescription assessment for clinical and legal errors, accuracy checking, and clinical decision making. In terms of van Merriënboer *et al,* (2002) 4C/ID model for instructional design, SCRIPT supports the learning tasks of the competency class by providing part-task practice: it does not simulate dispensing or the interactions with role play GPs and patients. However, to meet the definition of part task practice SCRIPT should focus on a single recurrent skill rather than multiple or non-recurrent skills (van Merriënboer *et al*, 2002). SCRIPT scenarios require students to practice both recurrent skills, such as accuracy checking, and non-recurrent skills, such as

prescription specific decision making. Therefore the use of SCRIPT does not fit this definition and could be considered to be learning task as opposed to providing part task practice. This may lead to the perception of SCRIPT as a simulation of real practice as opposed to the support for the competency based class which it is intended to be. It is not clear from this study if this difference in perception of SCRIPT is important in terms of overall engagement or in terms of achieving learning outcomes. This could be the focus of future research.

Theme 7 – Suggested changes to SCRIPT

There were a number of suggestions for changes that could be made to SCRIPT, in particular there were suggestions to reduce the ambiguity in error selection, "*the options should be clearer and more distinguishable so for students it's more understandable*" (S12.Collaborative) and to amend errors within the scenarios "m*ake the answer more accurate*" (S6.Home2+2). In addition, one student commented that they would "*like to know more about the marking [scheme]*" (S18.Home2+2), presumably to help rationalise the score obtained after completing a scenario or to inform them on how they would be marked during class assessments.

It was also suggested that staff could actively check the scenarios for errors suggesting that students would value greater quality assurance of SCRIPT would be valuable, "*questions should be checked by more staff, tested on them before they test it on the students*" (S15.Home). However there was a suggestion that this would be easier if students engaged in reporting errors to the SCRIPT editorial team "*correct the errors. But I guess it's quite hard if we don't report them*" (S4.Home).

There was a suggestion to amend the screen layout so that labels and registers can be checked with out flicking between tabs, "*if there was some way you could see [the label, prescription and patient information] all on the one screen 'cause that would make it more true to life I think,*" (S5.Home).

Students suggested that more scenarios may benefit the program "*maybe there could be more, different, examples*" (S9.Home) and the creation of a compilation test "*maybe…compilations…like combinations of every kind of sort of different kind of like prescriptions*" (S7.Home2+2) would help students who were using SCRIPT for revision. It was not clear if the suggested "compilation" test is any different to the revision test which was already available in the program. The suggestion for more scenarios may help explain why overall SCRIPT use appeared to be less for the Replacement than the Supplemental year. It is possible that students perceived less of a need to access SCRIPT outwith class teaching if they thought that they had completed all the scenarios during class time.

One student suggested that "*in the lab aspect maybe [having] a bit more time*" (S14.Home) would be helpful and another student commented that SCRIPT "*should be more colourful…it's boring*" (S10.Home2+2).

Summary of student perceptions

The qualitative interviews revealed that there was variety in the way in which students made use of SCRIPT in class and remotely. In particular in relation to the time required to complete scenarios, whether students chose to access SCRIPT alone or in groups, the way in which students targeted prescription types, and the sources of help that student perceived as useful. There are three quotes that highlight the variability in the way in which students chose to use SCRIPT:

> *"[the] feedback it gives you is really good because even if you have no idea, and just click submit it tells you like the right answer and why it's the right answer*" (S5.Home)

> "*I [used SCRIPT] with another [student] and we might discuss the answers before we submit and if there were any mistakes we just discuss why and what went wrong*" (S1.Collaborative)

> "*I've actually used SCRIPT since first year, cos I knew like a third year at work and stuff and I used it to help me train in dispensing and stuff so I knew of SCRIPT since I was in first year… it was quite good*" (S5.Home)

Although the interviews confirmed some aspects of the quantitative analysis it is clear that there is variety in the way in which students made use of SCRIPT so neither qualitative nor quantitative methods alone, can be used to determine how a cohort of diverse students chose to use an e-learning program. As such this study indicates that flexibility of an e-learning resource may be important in meeting the needs of a diverse cohort of students. In addition, the removal of ambiguity and errors from SCRIPT and improving staff engagement with SCRIPT may enhance students' perception of the program.

These findings support the work of Sun *et al*, (2008) who identified that increased quality and flexibility of an e-learning program can significantly improve student acceptance. In addition they highlight that staff attitude towards e-learning can directly affect student acceptance of the e-learning program. These are three areas that should be considered for maintaining or enhancing during future developments of SCRIPT.

3.6.5.2 Staff perceptions

Demographics of staff interviewed

Eight staff were interviewed, six of whom were either Teacher Practitioners (TP) or Teaching Fellows (TF) and two were Lecturers/ Senior Lecturers (L). Three members of staff were full time employees of the University and five were part time. All staff were registered with the General Pharmaceutical Council (GPhC) and five were currently practising in a community pharmacy.

The initial coding of the transcripts identified 89 codes which were then aligned to six key themes (Table 3.12).

Table 3.12 Themes identified from staff interviews

Theme number	Theme title
1	*Staff perception of student use: in personal time*
2	*Staff perception of student use: in class*
3	*Differences between subgroups*
4	*Staff awareness of SCRIPT (staff education)*
5	*Staff perception of SCRIPT*
	a. Supplemental
	b. Replacement
	c. *General*
6	*SCRIPT development*

Theme 1 – Staff perception of student use: in personal time

Staff believed that the majority of attempts on SCRIPT outside of class teaching would be around exam time "*maybe kind of leaving it until just before the test or whatever…they used it as a revision tool, it wasn't something that they used throughout*" (T5.L), because*" students worry about exams and they want to… get as much practice in beforehand*" (T7.TP). Staff believed that students probably only used SCRIPT at exam time "*because students are students [laughs] and although we want them to access it to enhance their learning they don't do it.*" (T4.TP) and several of the staff related this to the fact that SCRIPT "*was labelled as a revision aid*" (T5.L).

These staff perceptions are understandable because it is documented that one of the key requirements for e-learning acceptance is that it is linked to assessment (Davis, 1989; Sun *et al*, 2008; Wong *et al*, 2010). In addition, staff may also have based their opinions on personal experience of student attitudes.

Staff believed that student use would be dependent on the student's individual learning needs, *"[student use] depends on how much em, the student, em [pause] wants practice and how much the student really needs the practice and also it will flag up to them where they feel that they need to work on and what they need to look at*." (T7.TP). In general staff thought that the students' use of SCRIPT in their personal time would have increased after SCRIPT was used during class teaching (Replacement year). "*I imagine that they are more likely to have accessed SCRIPT following the integration [into class teaching]…I can't be certain but I guess they probably access it more readily*." (T1.TF).

Staff suggested that their belief that the use of SCRIPT in personal time would be greater after adopting the Replacement model would have been due to "*the way things are a bit more structured in the way that they are introduced to SCRIPT, now, that is, in the lab, for a half hour period or what ever, then they would be a bit more keen or whatever and do things*" (T6.L) and from students gaining familiarity with SCRIPT by using it in class time, "*[Students] have had a chance in the lab to do SCRIPT, by themselves, or with partners, or in a team, and I think that they would have learned from that and might well have gone and accessed it more outside*." (T1.TF).

Although the majority of the staff were confident that the students' remote use of SCRIPT would have changed after introducing SCRIPT into class teaching (Replacement) there were differences in opinion on whether this would have been a change in the total number of attempts made or a change in the pattern of use in relation to the time of the year. Some staff thought that the Replacement approach would have resulted in more frequent SCRIPT use over the year, whereas others thought that students would still only access SCRIPT at exam time.

> "*[Students might use SCRIPT differently], maybe using it immediately after the class, not necessarily leaving it for the 7-8 week in*

> *preparation for the exam but using it as a sort of weekly, type of reinforcive learning*" (T5.L)

> "*I still don't think that they would then go back to it until it was before exam time…they need a trigger*." (T4.TP)

Theme 2 – Staff perception of student use: in class

Staff described the class use of SCRIPT as "*forced*" (T3.TF) and commented that this would alter the way students use SCRIPT by default. They commented that this approach was good because, "*[the students] couldn't just leave it until the end of term it was something that [they] had to log into on a weekly basis, and it raised [SCRIPT's] importance because it was now something that was part of that class*" (T5.L). If students were not made to use SCRIPT in class they might have "*tried it a few times on their own they might have had a problem and might just have given up on it*" (T3.TF).

The benefits of using of SCRIPT in class allowed students to seek support from staff if required, "*if they weren't sure how to use or if something went wrong and didn't know why it was wrong they were able to come upon a member of academic staff and say "look why have I got this wrong" and it also helps them understand it a bit better*" (T7.TP). There was also a suggestion that staff supported the principles of adult learning (Knowles *et al,* 1998) in that they believed students could identify their own learning needs.

> "*you do see them…catching up on stuff that they have missed on previous examples or getting reading on for ones that have yet to come. So I don't know if that's because they know that they can still access them outside teaching… if they are saying "well I can access that outside", then that's fair enough. If it means, that, if it improves their performance in [the competency class] by making sure they've finished everything and they are ready for the next thing then I wouldn't have a problem with that*." (T3.TF)

As highlighted from the student interviews, staff attitudes may have influenced how students had perceived SCRIPT, and while the above comment indicates that staff are supportive of self directed learning, students may not have understood the educational principles behind this comment and perceive this as disengagement.

Theme 3 – Differences between subgroups

When asked if there were any differences in SCRIPT use between the student subgroups there were a variety of opinions raised by the staff. Although some staff did not perceive there to be any differences between the subgroups, there were a number of suggestions made by other staff members.

> "*Collaborative students might find it something that they would rush home and do… I think they rush off and discuss among themselves*." (T1.TF)

> "[*Collaborative] students tend to…like book type learning; they sort of like that type of thing …[they would have] made sure that they had done all the examples … that's how they like to learn. So my thoughts are that they might have used it more.*" (T3.TF)

> "*[Collaborative students have] a shorter time scale…their teaching is so condensed… [it] might appear that they access it more [than the Home students]*" (T4.TP)

> "*Home students are more likely to question what SCRIPT says*" (T5.L)

> ***"****Home students may use it as a reassurance type of tool, whereas the [Collaborative students] use it as a <u>definite</u> teaching/ learning tool*" (T5.L)

> ***"****[Home students will] forget about it until just before their exams…[Collaborative students] want to keep up the practise… they need to understand the UK scripts…[they] might use it more often during the year [after passing the competency class].*" (T7.TP)

> "*[Collaborative students] will be looking for clues about what may come up in the exam*" (T8.TF)

It is clear that a number of staff believe that there are cultural differences between the subgroups and that these may have influenced the way in which students used SCRIPT. However, further research would need to be conducted to determine if this was the case. Literature suggests that cultural differences may influence student use of e-learning resources (Tapanes *et al*, 2009), but this has not been proven in the context of SCRIPT.

Theme 4 – Staff awareness of SCRIPT (staff education)

In terms of staff awareness and involvement with SCRIPT, the majority of staff were not confident that they were accurate in their assumptions of how students had used SCRIPT, "*the only time I know for certain that they've been using it is during [competency based] class*" (T6.L). There were also a number of comments that indicated a degree of misunderstanding of the functionality and content of SCRIPT, "*as far as I could see in the class there were only a few examples available*" (T2.TF), "*I'm not sure that if they had done all the examples in the lab if there was anything for them to do outside the lab*" (T3.TF) and there were concerns about the impact of the email helpline, "*I don't know who deals with that… that might be a little disappointing for the student*" (T2.TF). Staff also indicated a degree of discomfort in dealing with student queries relating to SCRIPT, which may decrease the more SCRIPT is used.

> "*it's not always easy …..to ease your way out of it appropriately, without saying the wrong things, like "there's a glitch" or …"the feedback's wrong*" (T1.TF).

> "*[The] main weakness that we have with it is that the training [for staff and students].... I think the emphasis should be on the interpretation of the answers… It's like a cryptic cross word, you know if you do the same cryptic crossword over and over again, then you get into the thinking of the man who has written it so you can do it*

> *relatively easily compared to someone who has come in fresh*" (T8.TF).

It is clear that staff awareness and familiarity of SCRIPT could be enhanced and this may increase their confidence in dealing with queries from students. Again, staff engagement is essential to the success of an e-learning program (Greenhalgh, 2001, Cook & Dupras, 2004) and at the time of the interviews staff may have felt detached from the development of SCRIPT, for example none of the staff could recall any enhancements made to SCRIPT following evaluation of the 2007 – 2008 academic year and this may have affected their confidence in and awareness of SCRIPT in general.

Theme 5 – Staff perception of SCRIPT

a) Supplemental model

The majority of staff thought that aligning SCRIPT to the competency based class (Supplemental) had improved accessibility of SCRIPT, "*if they are going to use it more often then it's going to improve that, em, accessibility.*" (T1.TF) and that students "*might have been a bit discouraged if they had accessed something and they either hadn't done it or understand it…having access to work that they should have been able to do might have improved things*" (T2.TF).

As with the students, the purpose of SCRIPT was brought into question, as to whether it is intended as a revision tool or a teaching aid.

> "*Being dealt a random hand as it were, with a prescription might be useful to revising students at the end of the year, but I don't think that as a teaching tool that it improves matters at all. I think that they should be restricted to what they are learning at the time so that SCRIPT reinforces what is being taught*" (T6.SL).

b) Replacement model

The positive aspects of Replacement model from a staff perspective were that it increased the students' awareness of the SCRIPT resulting in increased student responsibility which enhanced the self directed learning skills required of pharmacy students, "*now [that SCRIPT] is integrated into the class, and now they are more comfortable and see it for what it is and are probably more proactive in using it*" (T5.L). Staff were also accessible should students require help, which made SCRIPT a "*more viable tool*" (T4.TP) and the inclusion of a SCRIPT rotation reduced the intensity in the class which staff believed that students would appreciate.

> "*It maybe takes the pressure off [the students] a little bit, I don't think it's necessarily too taxing so if they are under pressure. You are always chasing them time wise in the other scenarios, but the SCRIPT one always seems like relaxed so it maybe acts like a pressure valve for them*" (T8.TF)

A reduction in staff time with little change to the duties of remaining staff was reported as a positive aspect of the Replacement model. Some staff indicated that teaching was now less monotonous and that SCRIPT made the students better prepared for other aspects of the class and staff that they were "*able to get into conversations with them a little bit more having done the SCRIPT prescription*" (T5.L).

The staff believed that group work in the class was a good way for students to learn and that SCRIPT will have helped promote the principles of continuing professional development (CPD). SCRIPT was not perceived as a means of reducing staff time.

Not all staff comments were positive as staff felt that SCRIPT had a negative effect when "*SCRIPT's not working very well and in that case you are faced with maybe having to sort out problems*." (T2.TF) or when the number of student queries had increased staff load, "*you can find yourself getting dragged away*" (T8.TF). Once

again the function of SCRIPT was brought into question: "[*SCRIPT is] a really good tool for revision. I mean I think it's an excellent tool for revision, whether or not it's worth doing it in the class or not, I'm not sure*" (T2.TF). Given that staff engagement is key to the success of e-learning (Greenhalgh, 2001), it is important to consider these comments for addressing in future staff induction sessions.

c) General

All staff commented that the enhanced feedback was an improvement. However, some felt that it was not always correct or complete. As with the students staff thought that answers could be ambiguous.

> "*I think there are too many similarities which make it very ambiguous for the students and make it hard for us to explain exactly what the right and wrong answer should be*." (T3.TF)

However not all staff thought that this was a bad thing because it helped the students develop.

> "*Sometimes [students] thought that [the feedback] was contradictory to what they thought the answer was, but if anything it just made them question, the [resources], it made them question what they believed to be true so they had to go and find the correct answers. So whether it is ambiguous or not, I don't think it really matters because it got them to think*" (T4.TP).

The majority of staff commented that SCRIPT is a good or excellent tool, and thought that "*it has evolved quite well actually, I think it is in a good place in [the competency class]…I can't think of a better place to have it actually*" (T7.L) The main concern raised was that if technology failed on the day SCRIPT was to be used in class, this could be frustrating for staff who do not have editing rights, which can ultimately lead to SCRIPT getting a "*bad press*" (T1.TF).

> "*I don't have any control of [SCRIPT]…so you tell the students, "right on you go" and then they are saying they can't get in, or it's not there, or the wrong stuff is there. I guess that that's not to do with the actual content it's more to do with the process and how it's up and running*" (T3.TF).

Theme 6 – SCRIPT development

The most common suggestions for development were to rationalise the errors and to improve the mechanisms/procedure of feedback between staff and the SCRIPT team.

> "*The only thing would be to remove some of the ambiguity and that really will only happen if a member of staff could go through every single example and actually answer it, and that's quite time consuming*" (T5.L)

> "*The difficulty in practice is that in the class you find yourself under quite a lot of pressure… I don't know if there could be a way of improving the way we can feedback problems?*" (T8.TF)

> "*Some kind of formal way that staff who are teaching on the class could [feedback to the SCRIPT team]…the idea comes to you then the three hours is over it disappears again, and [none of the editorial team are] around so we can't pass on the information*." (T6.SL)

There was also a desire to give teaching staff (other than the SCRIPT editing team) the responsibility for ensuring that SCRIPT is working and up to date and to ensure that there is a procedure to review all prescription scenarios on a regular basis for consistency and accuracy although the time required for this was mentioned as a barrier.

> "*There should be one person responsible to ensure it is up to date and in charge of release dates so staff can rely on it*" (T2.TF).

Other suggestions included staff education on the interpretation of errors, increasing the complexity of the scenarios including, more patient information,

inclusion of ethical issues, and a larger revision test which includes everything. This is currently available which indicates a lack of awareness. It was also suggested that SCRIPT could be used to teach a systematic checking process by breaking down examples more simply, into dose checks, then counselling. This follows the logic of part task practice in relation to the 4C/ID model of instructional design (van Merriënboer *et al,* 2002).

A number of these suggestions were already available in the current program indicating that increasing staff awareness of SCRIPT content and functionality is a priority for more successful integration. However this would require an investment in time. A couple of the staff were aware of the development of SCRIPT as an accuracy checking tool and commented that this was a logical progression. All staff were positive when suggesting potential developments, phrasing comments in a constructive manner, which suggests that staff were engaged in the use of SCRIPT and were keen to see it succeed.

Summary of staff perceptions

Many of the comments made by the staff reiterated the findings of the student interviews. For example staff indicated that they perceived that there were ambiguities in the program and they suggested that they were uncomfortable answering questions related to SCRIPT during class time, which may explain why some students were reassured by this fact and others perceived this as a lack of engagement. However the overall feeling was that staff valued SCRIPT but would benefit from greater involvement to increase their confidence in the content and the technology.

Staff also made a number of assumptions on cultural differences between the subgroups which again suggests that there was diversity in terms of students' attitudes towards and perceptions of SCRIPT. As specified previously there is a

possibility that cultural differences and differences in learning styles may have influenced the findings in this study.

The participants of both the student and staff interviews thought that student use of SCRIPT would have been greater in a Replacement format than in a Supplemental format. However, the quantitative analysis suggests that the reverse was true. Further research would be required to draw conclusions on why staff and students had these perceptions. This may be achieved by investigating the extent and nature of groups using SCRIPT, in class and remotely, and by investigating how students actually interact with SCRIPT and each other.

In general staff were positive about the integration of SCRIPT into class teaching and noted that there was little impact on staff work load and that the integration may have improved how well students prepared for other rotations in the class.

3.7 Limitations of this study

There were a number of limitations to this study. The main weakness of the quantitative analysis was that student access data only contains part of the information about student activity while logged into SCRIPT. It does not tell us where the student logged in, why they logged in or what they were trying to achieve from using SCRIPT. The qualitative interviews revealed that students had adopted various approaches to using SCRIPT, for learning and for revision, but we do not know how this relates to the user access data for each student. In addition we do not know the extent to which students had worked alone or in groups. In terms of evaluating the impact of SCRIPT on learning, this study was limited because the competency based class was reported as a pass or fail. If a score or percentage had been reported for each student, linear regression could have been used to determine if there was a connection between this score and the number of attempts made on SCRIPT. However, this may not have added anything to the study because the results may have been limited due to confounding factors (Cook, 2005).

As for the qualitative aspects of this study, there were no student interviews with the Supplemental cohort because attempts to recruit for these interviews had failed. This is why the interviews with the Replacement cohort were conducted by final year project students to increase the number of students participating, and to reduce potential bias. However, this part of the study would have been benefitted from better representation from the Collaborative subgroup to ensure that the responses were representative of the whole cohort.

The staff interviews were not conducted by independent interviewers which could be perceived as a source of bias. However, this approach was chosen because there was a need for the interviews to be conducted by someone who understood SCRIPT, including the content, functionality, and history so that cues in the staff responses were acted upon with appropriate follow up questions. One approach to reduce potential bias would have been to conduct focus groups with support from

an independent researcher. This approach was not chosen because it would have required more time from teaching staff and there was a fear that some staff would have dominated the discussion. However, the interview transcripts could have been analysed by an independent researcher, rather than the PhD supervisor, to reassure that the themes identified were complete and accurate.

3.8 Conclusion

Pharmacy students made a considerable number of attempts at SCRIPT over the course of the year regardless of whether the Supplemental or Replacement model of integration was adopted. These attempts were predominantly during the students' own time and in preparation for class assessments. The total number of attempts made during personal study time was less in the Replacement year than in the Supplemental year and this may be due to greater familiarity with the program and greater clarity with respect to the link between SCRIPT and the competency based class. However, it is not clear the extent to which students chose to access SCRIPT as small groups rather than individually and it could be that experience of small group working during class time in the Replacement year may have influenced a similar approach out with class time. This would result in fewer attempts being recorded but further investigation is required to test this hypothesis.

The patterns of access varied from student to student which might reflect the time each student had to study, the timing of the assessments, differences in learning preferences and cultural differences. There were inconclusive findings as to whether community pharmacy experience had any influence on the student's pattern of use.

It is clear that different students used and perceived SCRIPT in different ways and this may be a result of learning styles or cultural differences. Twigg (2003) explains that "even the best "fixed menu" of teaching strategies will fail for *some* students", and Clark & Mayer (2008) indicate that learner control in terms of sequencing and pacing of content, as well the level of access to additional support can influence student engagement. As such, SCRIPT may be a good teaching or revision tool for some students but not others. However, SCRIPT may complement alternative pedagogical approaches to provide support to a wider range of students than the traditional class format alone.

Recommendations for future development of SCRIPT.

In response to this study a number of recommendations have been made for the future development of SCRIPT.

1. Improve clarification of error codes by removing ambiguity within the program. Both students and staff raised ambiguity as an issue, so each error code should be reviewed by an expert panel to ensure that all codes are required and clear to understand.

2. Removal of errors in the scenarios and improving the ease of error reporting. Both staff and students indicated that errors were a weakness associated with SCRIPT, and that they did not report errors to the editorial team.

3. Enhance staff engagement with SCRIPT through:
    a. Involving staff in reviewing the scenarios which may help remove errors in the program. However care must be taken to ensure consistency is maintained.
    b. Increasing staff awareness of SCRIPT through frequent meetings with the editorial team and other staff members to share concerns and best practice in supporting the students.

As identified by Cook *et al* (2008) the focus of future research should be on the comparison of different e-learning models to identify the most appropriate way in which to use technology to enhance learning rather than trying to decide whether to use it or not. With this in mind, there are a number of research opportunities that have been identified as a result of this study.

Future research opportunities identified in this study

1. To determine what students actually do when they use SCRIPT and why. This may require greater qualitative research with the addition of observational studies.
2. To determine the extent and nature of the group use of SCRIPT, in class and remotely.
3. To determine the extent to which SCRIPT should be used to support part task practice, for example accuracy checking, as opposed to complete learning tasks.
4. To determine if student usage preferences can be categorised into particular types and if there is any relationship between type and academic success.
5. To determine if there is any correlation between student learning and cognitive styles and their use of SCRIPT.

Cook (2012) highlights the importance of good instructional design instead of trying to cater for all of the students' learning styles. As such, the priorities of future development and research should be to implement the suggestions highlighted in this study and to then focus on the research opportunities that will inform the most appropriate use of SCRIPT as a tool to support the competency based class. This might result in a need to consider alternative integration models where SCRIPT should be perceived as part of the competency based class rather than an additional tool to support this class.

Chapter 4

The development of SCRIPT as an e-learning resource to support pre-registration training

4.0 The development of SCRIPT as an e-learning resource to support pre-registration training

4.1 Introduction

4.1.1 Registration with the GPhC

Registration as a Pharmacist in the Great Britain is regulated by the General Pharmaceutical Council (GPhC). The GPhC have established standards for the Initial Education and Training for Pharmacists (GPhC, 2011a) which list the standards that must be achieved through completion of a GPhC accredited University course and pre-registration training. The overall requirements that all prospective pharmacists must achieve before they are eligible to register with the GPhC include:

- Successful completion of a Masters of Pharmacy degree: minimum four years, full time duration
- Successful completion of a one year pre-registration training: during which a portfolio of evidence must be collected to demonstrate achievement of the GPhC performance standards.
- Obtaining a pass in the GPhC pre-registration assessment
- Meeting GPhC Fitness to Practise requirements (GPhC, 2012a)

There are alternative routes available for registration as a pharmacist in Great Britain if the applicant is already a pharmacist in another country. If they are practising in the European Economic Area (EEA) a pharmacist can register with the GPhC after clearing fitness to practise requirements. A pharmacist from a non-EEA country can also apply, but must complete an Overseas Pharmacists' Assessment Programme (OSPAP), which is one year in duration, before commencing pre-registration training. As such, the majority of pharmacists registering in Great Britain must complete a pre-registration training year in GB.

4.1.2 GPhC Pre-registration training

The Pharmacy Order 2010 (Pharmacy Order 2012) and the GPhC Standards for Initial Education and Training for Pharmacists and Technicians (GPhC, 2011a),

govern the Pre-registration training. The Pre-registration period comprises a 52 week full time training period, during which trainees must demonstrate achievement of the Performance Standards, and completion of a Registration Assessment. The Pre-registration training must take place in an accredited training site with one tutor, who is a registered pharmacist, for each trainee. To comply with EU law (Directive 2005/36/EC) six months of the year before registration, which is currently pre-registration training for the majority of graduates, must be in a patient facing setting. This means that training may take place in a community or hospital pharmacy although other aspects of pharmacy practice, such as industry, academia, veterinary pharmacy, primary care and in prison pharmacies, may be covered but only for a period of up to six months (GPhC, 2012b).

The Performance Standards and pre-registration assessment

The GPhC Performance Standards define the knowledge, skills and behaviours that are expected of a newly qualified pharmacist and are grouped into three headings, personal effectiveness, interpersonal skills, and medicines and health. Trainees must demonstrate consistent achievement in all the Performance Standards through collation of a portfolio of evidence obtained from their experience in practice. The Pre-registration tutor must assess their trainee's formally at 13 week intervals, with a final sign off of all Performance Standards expected by the end of the 52 week period (GPhC, 2012b). The trainees' knowledge is additionally assessed in the Pre-registration Assessment which is set by a Board of Assessors engaged by the GPhC in accordance with a pre-determined syllabus. The Assessment is a two paper multiple choice exam with an overall pass mark of 70%; the first paper tests the trainees' working knowledge in a closed book exam and the second paper tests the trainees' ability to use of resources and interpret information in an open book exam. The open book paper includes calculation questions which carry a 70% pass mark irrespective of the score achieved elsewhere in the assessment. The GPhC specifies the reference sources permitted for the open book paper (GPhC, 2012b).

Approved Pre-registration training sites and tutors

Pre-registration training must take place in training site which has been approved by the GPhC following submission of a premises application and accompanying training plan. The application is a declaration that confirms that the training site will provide adequate experience, with sufficient support, for a pre-registration trainee. The training plan must demonstrate how trainees will have opportunity to demonstrate all Performance Standards during their training at the premises (GPhC, 2012b).

Pre-registration tutors must be pharmacists who have at least three years experience in the sector of practice in which they wish to be a tutor. Although there are no specific approval application procedures, tutors are expected to assess themselves against tutor competencies, abide by the Standards of conduct, ethics and performance and undertake CPD relevant to the role of a tutor. Tutors are expected to work full time with their trainee, supervise them on a regular basis, ensure a pharmacist directly supervises the trainee at all times and meet with their trainee at least once a fortnight. The GPhC provides guidance for tutors who cannot meet all these requirements such as establishing joint tutoring arrangements (GPhC, 2011b).

4.1.3 NES Pre-Registration Pharmacist Scheme (PRPS)

In Scotland, all government funding for pre-registration training is made available through a national scheme organised by NHS Education for Scotland (NES): the Pre-registration Pharmacist Scheme (PRPS). The PRPS evolved in response to a report from the National Pharmaceutical Forum which highlighted inconsistencies in the quality of pre-registration training throughout Scotland. The intention of the PRPS was to reduce these inconsistencies through the establishment of a centralised recruitment process, a standardised training programme and by embedding quality management into pre-registration training. The ultimate aim was to ensure that; "*every pre-registration pharmacist funded by the NHS [in Scotland] receives support*

and a high quality training opportunity and experience, regardless of practice setting" (NES, 2012).

NES PRPS Education Agreement

All employers who become a part of the PRPS must sign an Educational Agreement with NES. The Educational Agreement includes an obligation for NES to provide a standardised educational programme and an obligation for employers to support this programme. In January 2011, in a review of the PRPS programme, it was agreed that there should be greater flexibility in the delivery of the programme to help trainees who had difficulty fitting study into work schedules and to avoid unnecessary time away from practice. To meet this need there was a focus on enhancing e-learning opportunities and the components of the programme was categorised are either:

- Core PRPS distance / e-learning resources which must be completed by all trainees
- Core topics which must be completed by all trainees through attendance at the PRPS regional tutorials
- Core topics which must be completed either through PRPS distance learning resources **or** as part of an employer programme
- Reference resources which can be used to meet individual trainee learning needs.

In preparation for the 2011 – 2012 cohort the SCRIPT editorial team proposed that the existing SCRIPT technology could be aligned to the newly identified learning outcomes. An analysis of trainees' learning needs was to be conducted and an investigation of the potential for SCRIPT to be developed to meet these needs was considered. There was an agreement that any enhancements should be piloted and evaluated in line with previous research.

4.2 Aim and objectives

The aim of this study was to complete a learning needs analysis with PRPS trainees in the 2010 – 2011 training year and to develop and to evaluate SCRIPT in line with this analysis during the 2011 – 2012 pre-registration year.

The objectives of this study were to

- determine the 2010 – 2011 trainees' perception of potential e-learning resources through questionnaires and focus groups.
- develop SCRIPT according to the identified learning needs for inclusion as a core resource for the 2011 – 2012 training year.
- determine trainee perceptions of the enhanced functionality of SCRIPT as a pre-registration resource.
- determine trainee usage of the enhanced functionality of SCRIPT in terms of total access; access in relation to time of the day, day of the week and time of the year.
- determine if trainee usage differed depending on previous experience with SCRIPT and the sector in which pre-registration training was undertaken.
- make recommendations for future development.

4.3 Population and setting

Trainee inclusion and exclusion criteria

All pre-registration trainees who were recruited into the NES PRPS in 2010 – 2011 cohort were included in the learning needs analysis. Trainees, in Scotland, who were not funded by the NES PRPS were excluded from the analysis.

All pre-registration trainees who were recruited into the NES PRPS 2011 – 2012 cohort were included in the pilot of the enhanced functionality of SCRIPT. Trainees, in Scotland, who were not funded by NES were excluded from the study.

Availability and introduction of SCRIPT

A demonstration version of SCRIPT was made available to all trainees in the 2010 – 2011 cohort at the time of the learning needs analysis questionnaire so that all trainees were familiar with the SCRIPT technology.

The enhanced SCRIPT program was made available to all PRPS trainees in the 2011 – 2012 cohort from 1st December 2011 to 1st August 2012. There was an update on 19th February 2012 to introduce an additional shortened assessment.

Program version

The version of SCRIPT used in this study (version 5.0) was hosted on a website dedicated to SCRIPT, as opposed to the Strathclyde University VLE, SPIDER. It comprised three tests including an example test which contained a selection of traditional SCRIPT scenarios and was available to all members and visitors of the external site.

Two accuracy checking tests were made available to the pre-registration trainees only via the external site under licence. One presented ten random accuracy checking scenarios and was available throughout the study period. The other was a

shortened version of this test which presented only three scenarios and was made available in February 2012.

4.4 Methods

4.4.1 Learning needs analysis

4.4.1.1 Data collection

Questionnaire

The perceived learning needs of the 2010 – 2011 cohort of pre-registration trainees were gathered though completion of an online questionnaire (Appendix 4.1). The questionnaire was designed with the PhD supervisor and tested for face validity by a NES Pharmacy representative. The questionnaire included four questions specific to the demographics of the respondents and previous exposure to SCRIPT; two questions using a five point Likert scale to assess students' perceptions of e-learning resources to aid preparation for the pre-registration assessment and practice as a pharmacist; the option to prioritise the suggested topics for development; and a free text box for comments and suggestions. The questionnaire was available via the Questback survey website from the 26th November 2010 to the 22nd December 2010. Trainees were notified of the questionnaire through NES Pharmacy ePortfolio messaging service and a reminder message was posted to all trainees on the 16th December 2010. The questionnaire responses were automatically downloaded by Questback and were exported as a Microsoft Excel spreadsheet.

All trainees were made aware that completion of the questionnaire was voluntary, that all responses would be anonymised and that responses could be used for on-going evaluation of SCRIPT.

Focus group

All trainees in the 2010 – 2011 cohort were asked if they would participate in a focus group to obtain their perceptions of an e-learning resource that could be available to pre-registration trainees. The focus group was conducted and recorded through teleconference facilities because participants were located throughout Scotland and this approach minimised disruption to their work based training. Trainees were sent a document (Appendix 4.2) on the 5th April 2011 which

contained background information on the research aims and objectives and a series of questions for them to consider before the focus group. The questions were designed to seek clarification of the responses from the online questionnaire and to determine if these responses were still applicable at this later stage of the year. The focus group was conducted on the 14th April 2011. During the focus group the trainees were offered the opportunity to add to each question until all responses were exhausted. Agreement was sought for all points raised during the discussion. The recording was transcribed and themes were identified. All trainees who participated in the focus group were sent an email on the 6th July 2011 to ask if their thoughts had changed since sitting the Pre-registration Assessment, which took place on the 24th June 2011.

4.4.1.2 Data analysis

Questionnaire

The questionnaire data were organised to allow interpretation, using Microsoft Excel. Any blank responses where the respondent had opened the questionnaire and then failed to complete any of the fields were removed from the analysis. One question was directed at trainees who had previously used SCRIPT and therefore only responses made by trainees who had indicated previous use were considered in the analysis of this question.

The responses to the Likert questions were analysed quantitatively and the prioritisation exercise was analysed by counting the number of times trainees rated a topic as first, second, third, fourth, and fifth choice. Preference was determined by counting the number of times a proposed topic was selected as a trainee's 1st preference, 1st or 2nd preference, and 1st, 2nd or 3rd preference. This method was chosen due to the ordinal nature of the data that was collected. Free text comments were analysed for common themes to help inform the semi-structure interview questions.

Focus group

The focus group transcript was analysed for themes to help inform program development. These themes were discussed and agreed with the PhD supervisor.

4.4.2 Evaluation of usage

4.4.2.1 Data collection

Program usage data

SCRIPT automatically recorded data of every access to a triplet of scenarios, which was exported to an Excel spreadsheet for analysis. The data were cleaned to remove any records relating to excluded trainees and any NES staff attempts. Any entries relating to access before or after the study period were also removed. Entries relating to a scenario which was opened but not completed which therefore contained no information in the answers column were removed from the analysis.

Trainee perceptions of the enhanced SCRIPT

Trainee perceptions of the program were determined through completion of an online questionnaire (appendix 4.3). The questionnaire was designed with the PhD supervisor and tested for face validity by a NES Pharmacy representative. The questionnaire included four questions specific to the demographics of the respondents, fourteen questions utilising a five point Likert scale, to assess trainees' perceptions of SCRIPT functionality, accessibility, preference for use in groups or alone, content and relevance to the pre-registration and pharmacy practice. A free text box was available for comments and suggestions. The questionnaire was released, through the external SCRIPT website, from 1st March 2012 to 31st March 2012. It was available to all students included in the study and a request to complete the questionnaire was sent via the ePortfolio messaging function. A reminder message was posted via ePortfolio messaging function on 19th March 2012 to encourage non-respondents to complete the questionnaire.

All students were made aware that completion of the questionnaire was voluntary, that all responses would be anonymised and that responses could be used for on-going evaluation of SCRIPT.

4.4.2.2 Data analysis

Pattern of trainee use of SCRIPT

Data were interrogated to determine the total number of SCRIPT attempts made. Data were sorted in accordance with the time, in hour blocks, at which an attempt was made. The number of attempts made in each hour was counted and a rolling average was applied, taking the average of three points, to help display the access trends over the day by taking account of fluctuations at individual time points. Data were also sorted and counted according to the day of the week and week of training. The week in which SCRIPT was made available to the trainees was considered to be week 1. All data were corrected to use per 100 trainees to account for the cohort size.

Trainee perceptions of SCRIPT

The questionnaire responses were analysed quantitatively to determine the demographics of the respondents and to determine majority opinion in the Likert questions. The free typed comments were analysed thematically and themes were agreed with the PhD supervisor.

4.4.3 Statistics

A Chi Square was used to determine if the questionnaire responses were representative of the study populations. A Mann Whitney *U* Test was applied to determine if there was any significant difference in the use of SCRIPT between subgroups of the study population, for hour of the day, day of the week and week of the year: the Bonferroni correction was used to minimise the risk of type 1 errors due to multiple measures. A Friedman's Pairwise comparison was used to determine if there was any statistical difference in the number of SCRIPT attempts

within the whole population and within each of the subgroups for hour of the day and day of the week. A Chi square was also used to determine if there was any difference between the way each of the subgroups had targeted the SCRIPT scenarios that were available to them.

All statistical analyses were conducted using the raw data and not the data corrected to use per 100 trainees.

4.4.4 Ethics

The NHS West of Scotland research and ethics service advised that ethical approval was not required for this study.

4.5 Results

4.5.1 Learning needs analysis

4.5.1.1 Questionnaire

Out of a potential 170 trainees, 96 (56.5%) responded to the online questionnaire on e-learning (1 trainee's data was removed because they failed to complete any of the questionnaire) (Table 4.1).

Table 4.1 Respondent demographics for learning needs analysis questionnaire

Respondent details	Frequency	Percentage
Female	75	78.1
Male	21	21.9
Sector of practice		
Community	64	66.7
Hospital	32	33.3
University		
Robert Gordon University	35	36.5
University of Strathclyde	61	63.5
Previous use of SCRIPT as undergraduate		
Yes	64	66.7
No	32	33.3

Although the number of female trainees who responded to the questionnaire was greater than the number of male trainees, this was representative of the 2010 – 2011 PRPS trainee cohort which comprised 133 (78.2%) female trainees and 37 (21.8%) male trainees (χ^2 = 0.02, P > 0.5). This was also true for the number of respondents from each university (χ^2 = 1.12, P > 0.5), but not for the number of respondents from each sector of practice (χ^2 = 8.33, P < 0.05), with a greater proportion of hospital trainees responding than community trainees.

A total of 60 of the 61 (98.4%) Strathclyde graduates reported using SCRIPT as an undergraduate and 4 of the 35 (11.4%) non-Strathclyde graduates also reported previous use of SCRIPT, despite the fact that their University did not have access to

SCRIPT. There was no further investigation into these findings but this may suggest that students were unsure of what SCRIPT was or that they obtained access from friends who attended a different University.

Trainees who reported that they had used SCRIPT as an undergraduate were asked if they thought it could be developed for use in pre-registration training and the majority thought that it could (n = 55, 86.0%) or could maybe (n = 8, 12.5%) be developed for pre-registration trainees. One trainee (1.6%) did not respond to the question and there were no negative responses. All trainees were asked if they thought the addition of an e-learning resource would be beneficial for preparation for the Pre-registration Assessment and for practice as a pharmacist. Ninety-three trainees (96.9%) either agreed or strongly agreed to both questions. There were no negative responses.

It is clear that calculations, practising accuracy checking and minor ailments were considered as important topics (Table 4.2). Prescribing, care planning and the drug tariff were commonly selected as 2nd or 3rd choice topics, and the contract services, Chronic Medication Service (CMS) and the Minor Ailment Service (MAS), were less favoured as potential e-learning topics. The format of SCRIPT that was available to undergraduates was not a preferred topic. Four trainees made additional suggestions, these were:

- issues related to the Medicines Ethics and Practice guide (MEP, 2010) in an exam format (1st and 5th preference);
- practising clinical checking of prescriptions (3rd preference)
- problem solving scenarios in exam format (5th preference).

Table 4.2 Preference of topic for SCRIPT developments

Topic	Number of counts as 1st preference	Number of counts as 1st or 2nd preference	Number of counts as 1st, 2nd or 3rd preference
Calculations	29	44	58
Accuracy checking	25	44	58
Minor ailments	19	38	52
Prescribing	8	21	35
Care planning	4	15	27
Drug tariff	3	14	24
Delivering CMS	7	10	15
Delivering MAS	0	2	13
Current format	0	2	2
Other	1	1	2

There were a number of free text comments, from which four themes were identified: preparation for the GPhC Pre-registration Assessment, preparation for real life practice, trainees perspectives on e-learning and the existing SCRIPT program (Table 4.3).

Table 4.3 Themes identified from free text comments

Theme	Number of trainees	Summary of statements
Preparation for the GPhC Pre-registration Assessment	9	A program could include questions on • The content of MEP, • Open and closed book statements, • Calculations, • Problem prescriptions • The drug tariff, • Exam-type problem solving examples.
Preparation for real life practice	8	A program could include practise with • Hospital prescription scenarios (for community trainees), • Community prescription scenarios (for hospital trainees), • Care planning (for CMS), • Accuracy checking, • Examples of "every day" queries, • Clinical checking, making use of the online BNF
Perspective on e-learning	7	• e-Learning is good for pre-registration training, • e-Learning is good for accuracy checking, • Interaction is essential rather than text alone, • All topics suggested would be good, • Short e-quizzes would be good given the pre-reg work load.
The existing SCRIPT program	4	• SCRIPT would be good for pre-reg, • SCRIPT was good at University, • Unaware of current format

4.5.1.2 Focus group

There were four trainees who attended the focus group via teleconference. Three trainees were female and one was male; two trainees were from hospital pharmacy and two were from community pharmacy; two trainees were familiar with SCRIPT at undergraduate level and two trainees had not used SCRIPT before. The analysis of

the transcript revealed five themes, Topic preference, Functionality, Anticipated usage, e-Learning to support pre-registration training and Barriers.

Theme 1 – Topic preference

The trainees confirmed the findings of the questionnaire, indicating that calculations are a priority because *"a lot of people are worried about the calculations part so I think a, uh, an e-learning tool for that would be really good"* (Trainee 1). They also suggested that accuracy checking and the drug tariff would be topics for future support, "*accuracy checking is going to highlight [as a student preference] 'cause it's not something you deal with or focus in a lot at university, same with the drug tariff.*" (Trainee 1); although there was a suggestion that it might be *"quite difficult to do accuracy-checking in a sort-of e-learning format…checking prescriptions…is a quite, almost a practical thing, uh, I don't know, I mean if you could develop something but, for it in an, in an e-learning tool that would be great"* (Trainee 1). All trainees agreed that these were the main topics of preference.

There was also a desire for *"questions and answers on, em, on CD, controlled drugs and legislations…legalities of prescription, em, storage requirements of different drugs"* (Trainee 2). This comment was made by a trainee who had not had experience of using SCRIPT as an undergraduate, so they might not have been aware that the original versions of SCRIPT covered each these topics. Other topics that were suggested included on-call issues, ethical dilemmas and prioritisation skills.

> "*ethical [dilemmas] is one that would probably be up there with calculations and drug tariffs*" (Trainee 2).
>
> "*prioritising situations because there's a lot of stress, especially on newly-qualified pharmacists and maybe preparing you for that as well through some sort of prioritisation question with suggested things to think about*" (Trainee 4).

> "*asking people when they're on call [in hospital] for a night or a weekend, did you get any calls or what was the issue about, how to resolve it, em, if there was something like that for practice for the program, em, that might log situations or real-life situations*" (Trainee 2).

There were suggestions that calculations could be "*divided up into sections*" (Trainee 2) and that an e-learning program might allow trainees from community pharmacy to scenarios with "*clinical based hospital information*" (Trainee 2) and for hospital trainees to practice assessment of "*minor ailments*" (Trainee 2).

The focus group allowed comparison with data obtained from the questionnaire to determine if topic preference changed over the year. These suggestions might have reflected the trainees' stage in their pre-registration year in that they were focussed on preparation for the summative registration assessment and practice as a qualified pharmacist but the topics were similar to those suggested in the questionnaire. Therefore, in the sample obtained, the topic preference had not changed over the year with calculations, accuracy checking and the drug tariff still being the most popular. There were also suggestions for real life experiences and situations, including ethical dilemmas. This suggests that an e-learning program might be applicable to trainees at all stages of their pre-registration year.

Theme 2 – functionality

Trainees suggested that an e-learning resource should time completion of scenarios or questions. There was a suggestion that this would be especially useful for calculations as this could help trainees gauge performance in relation to the assessment.

> *"thinking ahead to the exam you know, it is a set amount of time, you know because people want it, it might take them a while to practice and build to doing it quickly but having some kind of time format might be quite good to sort of, sort of simulate the exam*" (Trainee 1).

> "*you could maybe have something that gave you even an approximation of how long it has taken you…[so that you can] compare it to the next question to see if you were faster or something*" (Trainee 4).

However "*the program shouldn't stop you if you take too long*" (Trainee 3) and timing might not be appropriate for an accuracy checking program because "*if you put a time-limit on the accuracy one especially it would maybe encourage you to rush and miss something else*" (Trainee 4).

All the trainees agreed that formative feedback was important, "*as long as you got feedback where you could know where, where you need to work on*" (Trainee 3) and that a marking scheme would be useful because "*if you're able to save all your results over time you can see [your progress]*" (Trainee 1). However, the way the marking is presented does not matter "*as long as you can monitor your progress and see how you're doing*" (Trainee 3). There was some dubiety over the usefulness of an e-learning program as an assessment:

> "*something about the pass/fail element of it, em, how would you set a cut-off?*" (Trainee 2)

Although trainees suggested a scoring scheme which graded their performance would be helpful if followed up by discussion with their tutor:

> "*where you were graded you could use that in a discussion with your tutor at a weekly meeting on how you were doing and we could also, em, look at the print-out or, you know, sit-down with you and go over something with you*" (Trainee 3)

The trainees suggested a number of considerations for a calculations program. That it should be in a format that resembles the pre-registration exam, "*from a visual point of view, [it could look like the] format of the exam paper*" (Trainee 2). There was an emphasis on the importance of regular practice on calculations and the regular release of new questions which may be completed "*two weekly or weekly,*

just depending on your preference" (Trainee 2). All trainees agreed with this and that "*if [calculation examples] were more frequent[ly available] in a program like the SCRIPT program… with deadlines, dates etc in which you have to submit the answers…it would help you keep track of your progress*" (Trainee 2).

With regards to accuracy checking, one trainee commented that they had used multimedia to learn how to prepare extemporaneous preparations and they shared this experience to suggest how an accuracy checking program may work:

> "*in second year...we had a video clip, em, just how to prepare ointments and creams and how to, whatever, whatever the task was and [there] was a camera shot of just a person's hands kind of preparing the product and you could see the method by which they would do it and how to arrange ingredients and so forth, em, so maybe something like that which is a shadow of a person's hands checking a box of tablets or, em, you could see the person actually taking out the strip and em, with a view shot of the date, of the expiry date and em, the batch number and the number of tablets in it, em, and maybe a shot of the labels. Em, ensure, em, that everything was correct and if the, if the person viewing this kind of a clip could kind of stop and play, em, at their own discretion, em, that could be very one way around the problem*." (Trainee 2)

Another trainee suggested a program with an image of "*a prescription on the left-hand side and a little box at the top with like a label that you could accuracy-check the label against the prescription with some multiple-choice questions"* (Trainee 4). Several of the trainees requested multiple choice questions, highlighting a focus on the assessment: "*just sort of multiple-choice questions that much-like what you would be getting in the exam...say monthly, you focus on a different section of the drug tariff*" (Trainee 1).

Generally speaking the trainees thought that any e-learning should be aligned to the assessment and that there should be a way of tracking progress. This suggests that the trainees were motivated by success in the pre-registration assessment, and hence achievement of registration both extrinsic motivators (Knowles *et al,* 1998).

Theme 3 – Anticipated usage

All trainees commented that they would make frequent use of an e-learning resource.

> "*I would use it as part of my revision. I get bored looking at a book all day. It's quite good to actually put things into practice so I would probably use it most weeks as part of my revision plan even in (something) as part of my study time*" (Trainee 3).

> "*If it's online I would use it quite a lot actually*" (Trainee 1).

> "*I probably would use it for sort of short periods of time quite frequently, maybe, every once or twice a week [as part of my] revision schedule*" (Trainee 4).

All four trainees made similar comments with respect to their anticipated use of an e-learning program. This may be because these four trainees have a preference for this format of learning given that they all volunteered to participate in this study. This may also reflect the fact that these trainees were preparing for the registration assessment at the time of the focus group.

Theme 4 –e-Learning in pre-registration training

All trainees agreed that an e-learning resource should be optional and not compulsory. "*I think making it not compulsory is probably quite important*" (Trainee 2) but they commented that there would still be a "*high uptake of the program. You would get quite a high usage from people*" (Trainee 2). They suggested that "*maybe if you did have a system where you were graded you could use that in a discussion with your tutor at a weekly meeting*" (Trainee 4) which suggests that this would be a way of encouraging tutor engagement.

There was a suggestion that trainees should have control over what is made "*private or public"* (Trainee 1) to their tutor and that NES could make use of

anonymous data to correct the program if "*lots of people are getting the same question wrong*" (Trainee 1) in case the program is "*badly worded*" (Trainee 1) then this could be corrected quickly. In addition if someone is underperforming "*maybe NES could send them a message or an e-mail or something offering them extra assistance or saying they need extra help and if so, they can make themselves known"* (Trainee 2). These comments highlight that trainees want their learning to be personal, but do not want to cut off any sources of support should they require help.

There was a strong preference for e-learning to be oriented towards exam preparation. However this may be representative of the fact that this focus group took place in the two months before the registration assessment. None of the trainees mentioned any topics related to pre-registration induction that would be expected at the start of the year. This may be because there is adequate support for induction topics or because the trainees could not see the relevance now that they were focussing on the end of year assessment.

The trainees felt that an e-learning resource should be "*available as soon as possible*" in relation to the start of the training year. There was a suggestion that new sections or topics could be released following successful completion of a previous section:

> "*you do the first section and then the next section will become available after the first one is completed and so on and so forth. You do section one then section two becomes available but you won't be able to do section three until you have section two done" (Trainee 2).*

This forms the principle of faded practice and suggests a preference for a game-based, competitive approach to e-learning (Clark & Mayer, 2008). However, another suggestion was to "[*release] everything as soon as possible*" (Trainee 1) and a third trainee commented that "*suggesting completion times [would be helpful] so you're not overwhelmed*" (Trainee 4). This led to a compromise between the trainees by

allowing a self directed approach where by topics could be selected by individual trainees but with only one topic available at a time.

> "*once you have that one completed then … then the rest of the sections would become available but you could tick one so if you're targeting your own learning..."* (Trainee 2).

> *"...you don't need to do each section sequentially, [but] you would just maybe pick one at a time"* (Trainee 1).

There were clear differences in opinions between the trainees in terms of topic progression/availability, which might be reflective of different learning styles. Clark & Mayer (2008) suggest that a game-based approach may be more fun for trainees but care must be taken in development to ensure that the game is suitably structured to ensure that learning meets the intended outcomes. However, the intended learning outcomes need to be determined before selecting the most appropriate way to achieve these outcomes.

Theme 5 – barriers

The main barrier mentioned by the trainees was access to technology and problems associated with operating platforms. "*I'm okay where I am but I know some people can't access certain websites*" (Trainee 1). However, one trainee commented "*I have some issues accessing some* websites *but NES [resources] seems to work on my computer"*. Many NES resources are now electronic and only a few trainees complain that they cannot access these but NES advise that these issues are usually resolved. It is important to consider this finding because IT problems are common derailers of e-learning programs and minimising these issues could ensure greater user acceptability (Childs *et al,* 2005).

In response to the findings of the questionnaire and focus group it is clear that trainees would like support with calculations and accuracy checking. Minor ailments was popular as a second or third preference in the questionnaire but was only mentioned once in the focus group which suggests that trainees may have adequate

resources at present. NES had a target for trainees to complete the distance learning pack *Responding to minor ailments*, which would have been completed by the time of the focus group but not by the time of the questionnaire. The drug tariff was mentioned in the focus group but did not score this as highly as the questionnaire which may reflect the fact that it is a reference source for the pre-registration assessment, so it may have been in the trainees' minds at the time of the focus group. None of the trainees who participated in the focus group responded to a follow up email asking them to advise if their thoughts had changed after passing the registration assessment.

In response to this learning needs analysis, SCRIPT was developed as an accuracy checking program to help trainees gain competence and confidence in their accuracy checking process. This decision was supported by recent research which highlights the risk to patient safety associated with errors made during the accuracy checking process (James *et al*, 2009) and the importance of incorporating accuracy checking into either the undergraduate or pre-registration training curriculum (James *et al*, 2010). Although SCRIPT already contained calculations within the scenarios, and could have been easily enhance in this direction, an alternative program was made available to trainees to help them to develop their calculation skills. This may be a considered as a topic for future development of SCRIPT.

4.5.2 Evaluation of usage

Demographics

A total of 172 trainees were permitted access to SCRIPT; 113 were female. Of these 129 trainees undertook the majority of their training in the community pharmacy sector and 43 were based in a hospital pharmacy. In terms of undergraduate education 95 trainees obtained their MPharm degree from the University of Strathclyde and 77 attended a different University (non-Strathclyde).

Total access

An analysis of the number of attempts made by students, and the percentage of students who accessed SCRIPT at least once indicates a number of similarities and differences within the variables, sex, sector of practice, and the university from which the trainee graduated (Table 4.4).

Table 4.4 Demographics of trainees in the 2011 – 2012 pre-registration training year

	Number of trainees permitted access	Number of trainees who accessed SCRIPT (%)	Median number of attempts per student (IQR)	Number of attempts at SCRIPT per 100 trainees
Sex				
Female	114	98 (86.0)	3.5 (2 – 5.75)	499
Male	58	49 (84.5)	3 (1.25 – 4.75)	426
Sector of practice				
Community	129	112 (86.8)	3 (1 – 5)	440
Hospital	43	35 (81.4)	2 (2 – 5)	577
University				
Non-Strathclyde	77	63 (81.8)	3 (1 – 5)	466
University of Strathclyde	95	84 (88.4)	3 (2 – 5.5)	481
Overall	**172**	**147 (85.5)**	**3 (1.75 – 5)**	**474**

A Mann Whitney *U* test revealed that there were no statistically significant differences ($p > 0.05$) in the total number of attempts within any of the subgroups in this cohort. This indicates that total use of SCRIPT in pre-registration trainees is similar regardless of sex, sector of practice, or the School of Pharmacy from which they obtained their MPharm degree. Previous experience in using SCRIPT did not appear to affect the trainees' overall use in pre-registration training. Although

SCRIPT scenarios are community practice based, there was no statistically significant difference between the total number of attempts made by hospital pharmacy trainees compared to community pharmacy trainees. The population that used SCRIPT was representative of the total population in terms of sector of practice, ($\chi^2 = 0.764$, $p > 0.05$).

Use in relation to time of day

The majority of attempts on SCRIPT occurred between 09.00 and 00.00 (Figure 4.1) with two peaks in activity between 12.00 and 17.00, and then at 19.00 and 22.00. A Friedman's Pairwise comparison revealed that, generally speaking, the number of attempts made in each hour between 12.00 – 22.00 were statistically greater than the number of attempts made in each hour between 01.00 – 09.00 ($p < 0.05$).

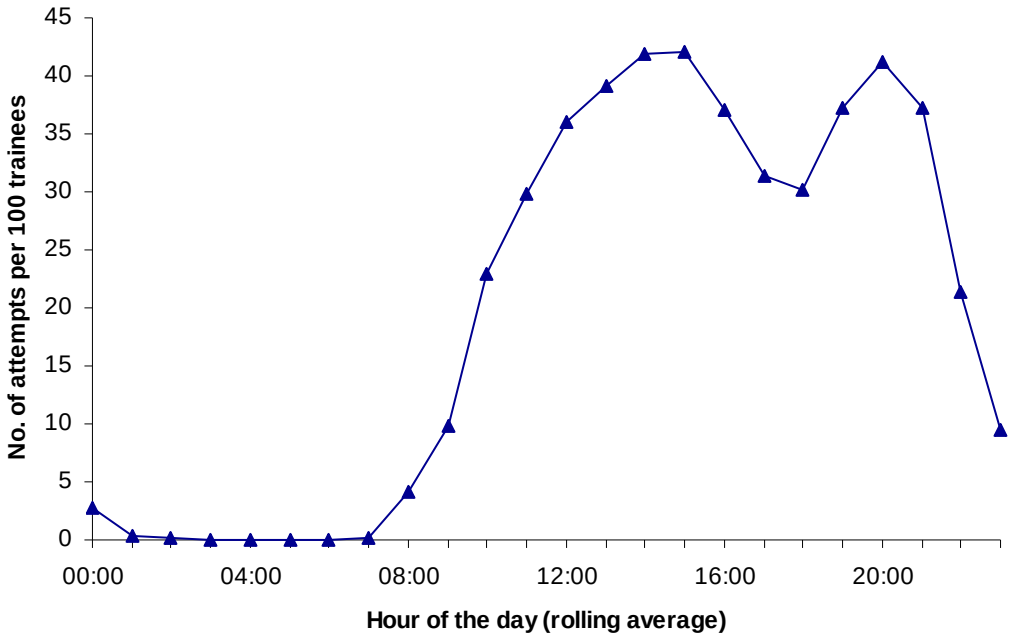

Figure 4.1 Rolling average of SCRIPT access per 100 trainees in relation to the 24 hour clock.

Comparison based on School of Pharmacy attended

Comparison of trainees who had studied at the University of Strathclyde and non-Strathclyde Universities showed that the pattern of use in relation to the hour of the day was similar (Figure 4.2) and there was no statically significant difference in the number of attempts made at hour of the day.

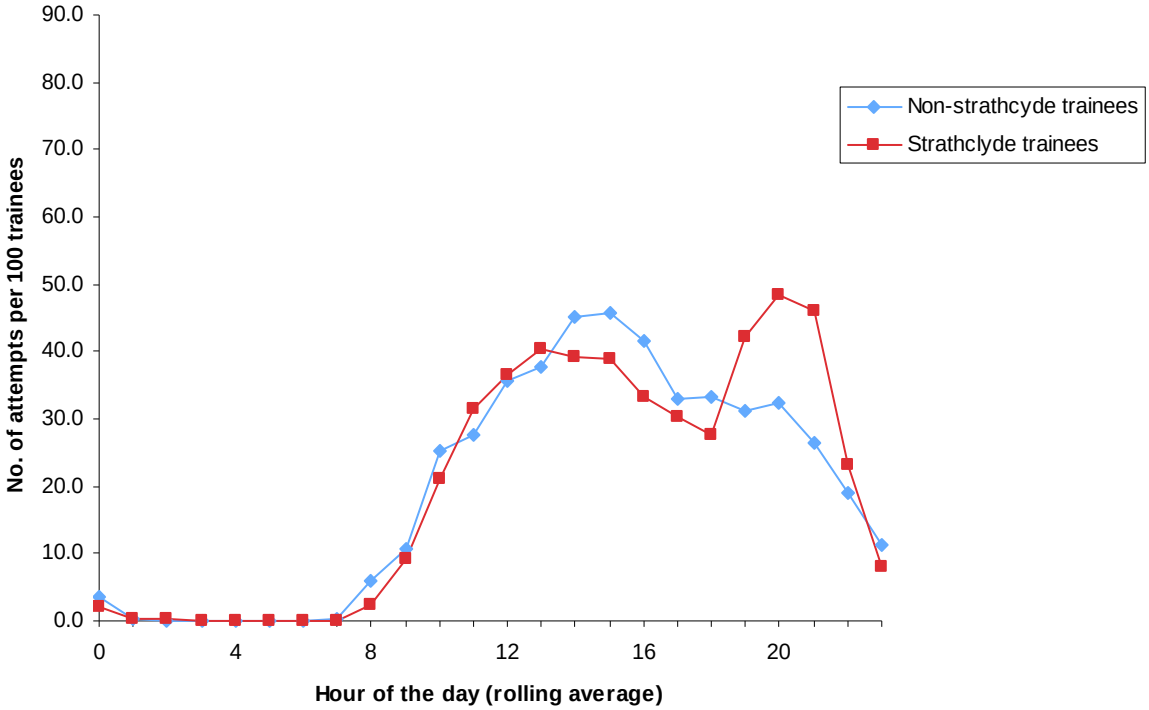

Figure 4.2 Number of SCRIPT attempts by hour of the day standardised to 100 trainees – according to School of Pharmacy attended.

The hours with greatest number of attempts for the Strathclyde subgroup were 15.00 – 16.00, 17.00 – 18.00 and 19.00 – 22.00. These were statistically significantly greater than the hours with the least number of attempts, 01.00 – 08.00, 02.00 – 08.00 and 01.00 – 09.00, respectively (Friedman's pairwise comparison, $p < 0.05$). This indicates that this subgroup had a preference for accessing SCRIPT during the late afternoon and the evening. This also indicates that there was a drop in the number of attempts made between 16.00 and 17.00, and then again between 18.00 and 19.00. A number of factors may have contributed to this finding such as

trainees commuting from work, eating their evening meal, or if they were still working at this time, perhaps this was not a common time period for study.

The trainees who had not studied at Strathclyde had a preference for using SCRIPT during the afternoon and early evening, and the hours with greatest number of attempts for the non-Strathclyde subgroup were between 1400 – 1700 ($p < 0.05$, in comparison to 0200 - 0800). There was no obvious reason for the differences in preference observed for each subgroup. However SCRIPT was listed as a core element of the PRPS programme and as such the non-Strathclyde graduates may have treated SCRIPT in this context. They may have allocated part of the half day study time each week, which would be during the day, to familiarise themselves with SCRIPT. The Strathclyde graduates who were more familiar with SCRIPT may have chosen to access it in the evening as part of self motivated study time, using their half day study time for other elements of the core PRPS programme. That said, the number of attempts made during this study was low which limits the generalisability of the findings

Comparison based on sector of practice

A comparison of the two sectors indicated a similar pattern of use across the day, but with the hospital trainees making more attempts than the community trainees in the hours 13.00 – 14.00 ($U = 2165.5$, $p < 0.01$) and 14.00 – 15.00 ($U = 2240$, $p < 0.05$) (Figure 4.3).

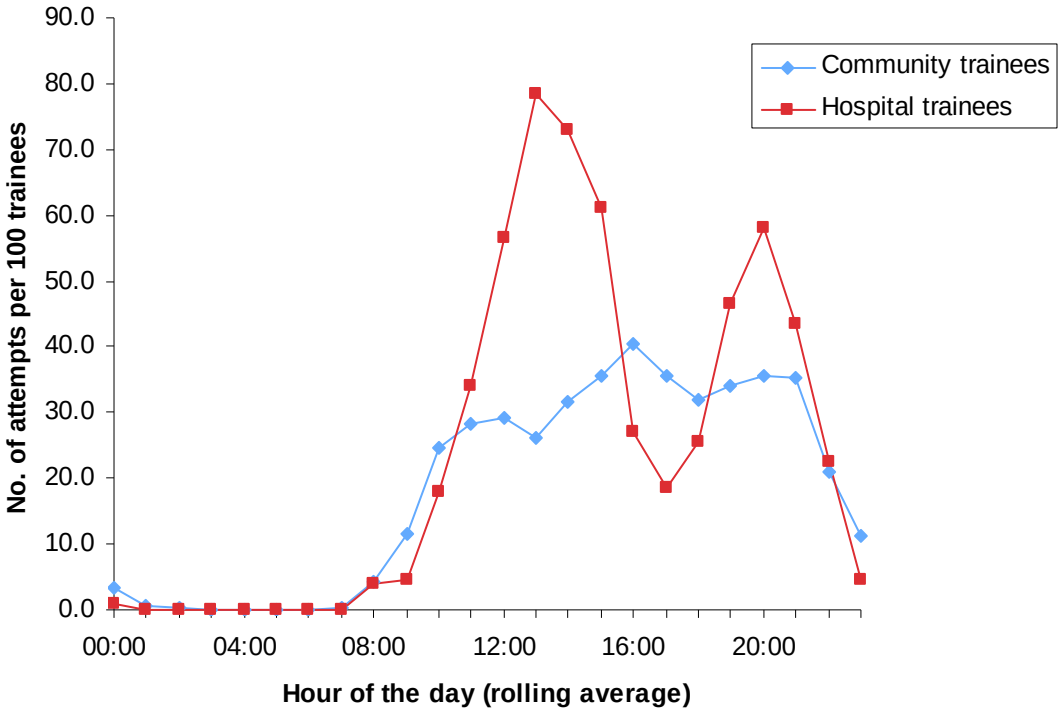

Figure 4.3 Number of SCRIPT attempts by hour of the day standardised to 100 trainees – according to Sector of practice

Although a statically significant difference was not demonstrated across all hours of the day it appears that hospital trainees targeted their SCRIPT use in a more defined time frame than the community trainees. However, care must be taken with this assumption because comparing the number of attempts made within the subgroups, using a Freidman's Pairwise comparison, revealed that the community trainees made a statistically significantly greater number of attempts between 14.00 – 18.00 and 19.00 – 22.00, compared to 02.00 – 08.00 ($p < 0.05$): however, there was no statistically significant difference in the number of attempts made between any hour of the day for the hospital trainees. Further analysis reveals that the peaks noticed within the hospital subgroup between 12.00 – 16.00 and 19.00 – 22.00 were exaggerated by a single trainee who had made several attempts during these time periods. Thus the pattern of use was not representative of the subgroup as a whole.

Use in terms of day of the week

Analysis of SCRIPT use on each day of the week indicated that there was consistent access over the course of the week (Figure 4.4). There was no statistically significant difference in the number of attempts made according to the day of the week according to University attended (Mann Whitney *U* test, $p > 0.05$) or sector of practice (Mann Whitney *U* test, $p > 0.05$). This may indicate that neither previous use of SCRIPT nor sector of practice influenced the pattern of use according to the day of the week in pre-registration training.

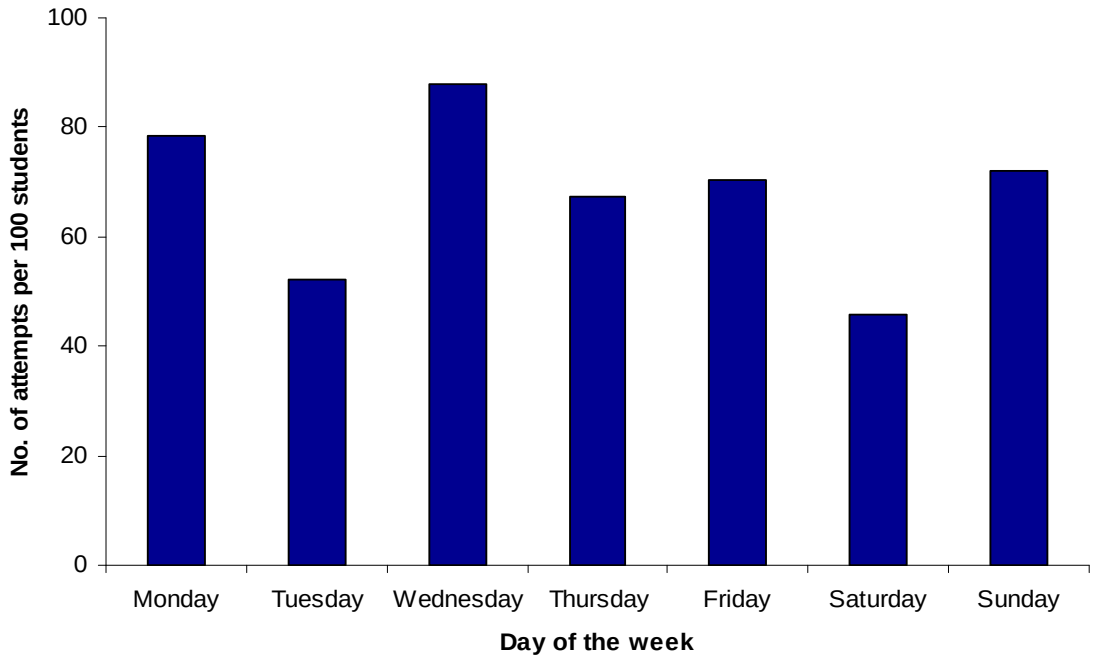

Figure 4.4 Number of SCRIPT attempts by day of the week standardised to 100 trainees

Use in terms of week

The majority of attempts made on SCRIPT occurred in the first nine weeks after it became available to the trainees. There were three peaks in use during this time at weeks 2, 6 and 8. The first of these peaks coincided with an email from NES staff indicating the availability of SCRIPT (week 1 – 2/12/2011). It is not clear if anything influenced the peaks at weeks 6 and 8. The number of attempts per 100 trainees

dropped shortly after an email requesting feedback on the use of SCRIPT during week 9 (23/01/2012). It is not clear if this email had any influence on the reduction in use from this week or if trainees only saw benefit from accuracy checking function up to this point in the year. A request to complete an evaluation questionnaire (week 13 – 04/03/2012) did not appear to influence the weekly use of SCRIPT which remained extremely low (fewer than 5 attempts per 100 trainees).

The pattern of use was similar for trainees who had studied at the University of Strathclyde and non-Strathclyde universities (Mann Whitney, $p > 0.05$) on all weeks except week 9, where the Strathclyde trainees made more attempts than the non-Strathclyde trainees ($U = 4090$, $p < 0.05$). Although the non-Strathclyde trainees appeared to access SCRIPT more that Strathclyde graduates in week 2, which may suggest familiarisation with the new program (Freasier *et al*, 2003), there was no statistically significant difference in the number of attempts on this week ($U= 3309.5$, $p > 0.05$). There was no statistically significant difference in the number of attempts made on any week between the students from each sector of practice (Mann Whitney, $p > 0.05$).

There were fewer than 5 attempts per 100 trainees made on SCRIPT each week, after week 10. Trainees who had participated in the learning needs analysis focus group had demonstrated a preference for a program that was linked to the registration assessment. The accuracy checking scenarios that were developed were not directly aligned to the assessment but were designed to help develop skills required to achieve the performance standards. Therefore trainees may have been focussed on preparation for the registration assessment after week 10 or had perceived achievement of accuracy checking competence; therefore did not see the benefit in using SCRIPT after this time.

Tests targeted

Of the three tests available to the trainees the ten scenario accuracy checking test was the more accessed (Table 4.5). The shorter, three scenario accuracy checking test was only accessed four times per 100 students, suggesting that this was not a popular test. Although not intended as part of this study, trainees made a number of attempts at the Example test which contains scenarios which were not restricted to accuracy checking. This indicates that the trainees' motivation to access SCRIPT may not have been based on their need to practice accuracy checking alone. However, a Wilcoxon signed ranks test indicated that the trainees made a statistically significant greater number of attempts at the Accuracy checking test (10 scenarios) than the Example test ($z = -4.839$, $p < 0.001$). However, there was no statistically significant difference in the preference for Example test comparison to the Accuracy checking test (10 scenarios), for students in hospital or community practice ($\chi^2 = 5.45$, $p > 0.05$) nor for trainees from Strathclyde or non-Strathclyde universities ($\chi^2 = 5.30$, $p > 0.05$). The attempts made on the accuracy checking test (3 scenarios) were not included in this comparison because the number of attempts was too few.

The example test was available as a default option in the version of SCRIPT used in this study, it was not intended to be used to support pre-registration training because trainees from the 2010 – 2011 cohort had indicated that this format of SCRIPT was not of high preference for pre-registration trainees. This finding suggests that the traditional format of SCRIPT might be of more use to pre-registration trainees that previously suggested. This needs further investigation.

Table 4.5 Total tests targeted standardised to 100 pre-registration trainees

	Example test (%)	Accuracy checking test – 10 scenario (%)	Accuracy checking test – 3 scenario (%)	Total
Sector				
Hospital	162 (36.8)	273 (62.0)	5 (1.1)	440
Community	265 (45.9)	312 (54.1)	0	577
University				
Non Strathclyde trainees	165 (35.4)	300 (64.4)	1 (0.2)	466
Strathclyde trainees	206 (43.3)	268 (56.3)	6 (1.3)	476
All trainees	**188 (39.6)**	**283 (59.6)**	**4 (0.8)**	**475**

4.5.3 Student perceptions of SCRIPT

Nineteen (11.0%) of the 172 trainees completed a SCRIPT evaluation questionnaire (Table 4.6 and 4.7) with the respondents being representative of the total population in terms of sex ($\chi^2 = 1.534$, $p > 0.05$) and school of pharmacy attended ($\chi^2 = 0.058$, $p > 0.05$). Although a Chi square indicated that the respondents from each sector of practice were representative of the total cohort, there was one expected value of less than 5, which suggests that this may not be a reliable result (Hinton, 2004). This is an indication of a low response rate.

Trainees were asked to estimate their use of SCRIPT over the year and the majority (n = 11, 57.9%) suggested that they had made between 2 and 4 attempts at SCRIPT. Two trainees had made between 5 and 10 attempts and two trainees had made more than 10 attempts. Three trainees had attempted SCRIPT once.

Table 4.6 Demographics of respondents to evaluation questionnaire

Respondent details	Number (%)	Total population (%)
Sex		
Female	15 (78.9)	114 (66.3)
Male	4 (21.1)	58 (33.7)
Sector of practice		
Community	15 (78.9)	129 (75.0)
Hospital	4 (21.1)	43 (25.0)
University attended		
non-Strathclyde University	9 (47.4)	77 (44.8)
University of Strathclyde	10 (52.6)	95 (55.2)
Accuracy checking included in employers programme		
Yes	7 (36.8)	-
No	12 (63.2)	-

Table 4.7 Trainee responses to the evaluation questionnaire

Comment	Level of agreement				
	strongly agree	**agree**	**neutral**	**disagree**	**strongly disagree**
SCRIPT was helpful during pre-registration training.	2	12	3	0	2
SCRIPT was useful preparation for practice as a registered pharmacist	2	10	5	0	2
SCRIPT increased my confidence in accuracy checking labels.	2	5	4	5	2
I would use SCRIPT once I am a registered pharmacist	0	3	6	7	3
The technology underpinning the SCRIPT was reliable.	2	3	5	7	2
SCRIPT was helpful in clarifying problem areas.	1	5	9	2	2
The dropdown menus in SCRIPT are confusing	4	5	3	7	0
I would prefer to use SCRIPT in a small group	0	2	7	9	1
The feedback provided in SCRIPT was helpful in clarifying problem areas	1	8	5	4	1
SCRIPT should be available to all pharmacists	0	10	6	2	1
SCRIPT should give a mark as well as feedback	2	9	8	0	0
I had difficulty using SCRIPT because of the technology.	0	3	5	6	5
I would prefer to use SCRIPT on my own	2	8	8	1	0
I disagreed with the marking and feedback	0	3	8	8	0

The majority of trainees agreed or strongly agreed that SCRIPT was helpful during pre-registration training (n = 14, 73.7%) and in preparation for becoming a pharmacist (n = 12, 63.2%). Although the majority agreed or strongly agreed (n = 10, 52.6%) that SCRIPT should be available to all pharmacists, only 3 trainees (15.8%) agreed that they would use SCRIPT once qualified. Six trainees (31.6%) were undecided on these statements. It is possible that the trainees thought that all pharmacists should have an opportunity to use SCRIPT, even though some might not choose to do so if registered and practising. Perhaps part of the reason for this is that pharmacists will make use of accuracy checking skills on a daily basis once registered and this version of SCRIPT was intended to help with the initial development of these skills.

There was no clear agreement on whether trainees felt that SCRIPT was helpful in clarifying problem areas or if it helped trainees increase their confidence in their accuracy checking skills. Despite the low response rate, this is an important finding because trainees would have to find SCRIPT useful if they were to choose to access it (Sun *et al*, 2008). Qualitative interviews could be considered for future studies to try and clarify such responses.

Although the majority of trainees (n = 11, 57.9%), did not have difficulty using SCRIPT because of the technology there were several trainees who thought that the technology underpinning SCRIPT was unreliable (n = 9, 47.3%). Although this did not reach the majority, the reliability of the technology is important for learner engagement of e-learning resources (Sun *et al*, 2008; Wong *et al,* 2008). Barriers to the success of e-learning in relation to technology can result from hardware, software or connectivity problems (Masters & Ellaway, 2008). It would have been helpful if the students could have clarified what technology problems they had encountered so that these could be minimised in future. NES encouraged trainees to undertake their study time in the workplace, which meant that trainees had to rely on their employer's IT systems. There is no guarantee of the standard of IT

systems in each place of work, which might be one potential source of the problems as was suggested by the students in the focus group during the learning needs analysis. Although further research might help clarify this finding, NES could consider allowing trainees freedom to use their study time at home or at a site with guaranteed internet access.

Nine trainees found the dropdown menus confusing. Even though this did not reach a majority this is important because quality in e-learning is essential for learner engagement (Sun *et al* 2008). The intention of this questionnaire was to evaluate the accuracy checking element of SCRIPT but over a third of the attempts made during this study were on the example scenarios which were selected from the undergraduate version of SCRIPT. It is important to clarify this finding before recommending changes to the program in case this feedback relates to the wording in these scenarios rather than the accuracy checking tests.

With regard to feedback and marking, there were inconclusive findings as to whether the feedback in the program had helped trainees identify problem areas. In addition the majority of the trainees indicated that they disagreed with the feedback “sometimes” or “often”. Again, further qualitative research could help find more detail on why this may be and again it is important to address this based on the work of Sun *et al* (2008).

Interestingly the majority of trainees indicated that they think the program should provide a mark as well as feedback and there were no trainees who disagreed with this comment. This may be related to the desire to monitor progress which was suggested by trainees from the previous year but it might also indicate that trainees perceived this version of SCRIPT as a game in that they desire a competitive element to the program.

The majority of trainees indicated a preference for using SCRIPT on their own (10 trainees 52.6%). This was supported by the fact that the same number of trainees indicated that they would not like using SCRIPT in a small group (10 trainees 52.6%). There were 7 (36.8%) and 8 (42.1%) trainees who made a neutral response to each of the questions, respectively. In the study of SCRIPT use in undergraduate pharmacy education there was a mixed preference for using SCRIPT alone or in groups, which appears to differ from the finding that pre-registration trainees did not have a desire for using SCRIPT in a group. This may be due to the fact that the undergraduate version of SCRIPT was designed to help students studying for a competency based class, through the development of knowledge and problem solving skills, which may have benefited from a constructivist approach to learning (Bangert, 2004; Clark & Mayer, 2008). In contrast, the pre-registration version was intended to help trainees develop a process for accuracy checking prescriptions and as such a response strengthening orientation may be sufficient for the intended learning outcomes (Clark & Mayer, 2008). It is worth noting that the University of Strathclyde graduates from this study were from the Replacement cohort of the previous study.

Although there were only five trainees who made free text comments, these comments were valuable to help inform program development. Two trainees indicated that the addition of an accuracy checking function was a good idea but one of these trainees thought this would be more useful as an undergraduate level "*where there isn't an opportunity to see real prescriptions*" (Trainee 1). All five trainees thought that the answers contained in the scenarios were either "*a bit ambiguous*" (Trainee 3) or "*not entirely correct*" (Trainee 2), and one trainee commented that this "*made me doubt what was the right answer*" (Trainee 5). There was also a suggested that inclusion of a worked example may help minimise these issues which is supported by the principles of good instructional design (Clark & Mayer, 2008).

There was one comment that suggested that trainees were not using the program as originally intended, which may have effects on the achievement of improved accuracy checking skills in real practice:

> "*I used the dropdown menu as a [“tick box" to confirm] that the label was correct additional warning label not required etc. However this would not be present when checking a real prescription*" (Trainee 1).

This comment reinforces the findings of the undergraduate studies in that learners will use e-learning resources in a variety of ways which cannot always be predicted during program development. Overall these findings suggest that further qualitative research could be conducted to inform future developments of SCRIPT as a resource to support accuracy checking.

James *et al* (2009) highlighted the risk to patient safety due to errors made during the accuracy checking process and James *et al* (2010) highlighted the importance of incorporating accuracy checking into either undergraduate or pre-registration training curriculum. However, they acknowledge that the accuracy checking procedure that one pharmacist chooses to follow can differ significantly from that of another and that there is little guidance available on how this competency should be assessed. Although not an assessment of accuracy checking skill the SCRIPT accuracy checking scenarios were intended to help meet this educational need. These scenarios were focussed on developing a single recurrent skill which forms part of the whole prescription checking procedure thus it follows the principles of the 4C/ID instruction design model (van Merriënboer *et al,* 2002). Unlike the original SCRIPT scenarios the accuracy checking models allows a part task approach which should be present alongside the whole learning task for which it is intended to support. In this case the learning task is the preparation and assessment of prescriptions in the workplace. Further research will be required to determine the most appropriate way to support the development of safe and effective

prescription checking. In particular it is important to establish at which stage of initial pharmacy education, accuracy checking should be taught.

4.6 Limitations of this study

The limitations of this study were that it was descriptive in nature and as such does not indicate if the use of SCRIPT affected accuracy checking competence. The number of attempts made by the cohort as a whole was too few to draw firm conclusions on trainee use. In addition, it is not known if SCRIPT use was influenced by practical accuracy checking experience in the workplace, which will have differed between trainees. There was a very low percentage of trainees who responded to the questionnaire so feedback was limited and may not have been representative of the whole pre-registration cohort. Kirkpatrick (1994) advises that to evaluate reaction a 100% response rate should be obtained immediately following a traditional education programme. In terms of e-learning it is impossible to "*have participants return their reaction sheets before they leave the room*" (Kirkpatrick, 1994 p36). Smith (2002) suggests that low response rates may be considered as acceptable if the quality of the responses are high enough but this suggestion was based on a response rate of 32%. McNulty (2008) indicates that surveys administered online can expect a lower response rate than paper based alternatives with a population of 150 requiring at least a 12% to ensure a confidence interval of 80%, which the authors refer to as "liberal conditions". This study obtained a response rate of 11%, with few (n = 5) free text comments. As such the results may not be useful for summative evaluation of SCRIPT, but they can be useful to provide advice on programme development (McNulty, 2008), which was the intention of this study. The provision of incentives may have led to greater response rates but this may introduce potential risks including effects on non-response bias, funding and ethical considerations and increased cost of research (Smith, 2002, p23).

4.7 Conclusion

The learning needs analysis that was conducted in the 2010 – 2011 training year indicated that pre-registration trainees would value an e-learning program which would help them develop their calculation skills and accuracy checking skills. A separate numeracy assessment and support program was provided to NES pre-registration trainees, so SCRIPT was developed to support trainees to develop accuracy checking skills.

The analysis of trainee use of SCRIPT to support accuracy checking was conducted during the pre-registration year 2011 – 2012. The trainees only made attempts at SCRIPT during the first nine weeks it was made available, with most attempts being made during the day and early evening. There was no preference for a particular time of day and neither the trainee's sector of practice nor school of pharmacy attended appeared to influence the trainee's use of SCRIPT. The analysis of the responses to the evaluation questionnaire indicated that trainees found SCRIPT helpful but there were a few suggestions for development highlighted in the responses to the questions and in the free text comments. However, given the poor response rate and the number of neutral responses it is difficult to draw firm conclusions from this analysis. This part of the evaluation would benefit from qualitative methods to help inform future developments.

Considerations for future developments

In principle the focus of future developments should be to enhance the trainees' perceived ease of use and perceived usefulness of SCRIPT as an accuracy checking program. This is essential to improve learner acceptance (Davis, 1989) and greater use of SCRIPT. This study identified four key considerations for the development of SCRIPT as a tool to support the accuracy checking.

1. To remove ambiguities in the error selection process through review of each scenario and the wording of the errors.

2. To introduce a face to face induction session to supplement the program instructions (Pituch & Lee, 2006), to help trainees identify the role of SCRIPT in relation to pre-registration training and to minimise issues associated with error interpretation or technology. The inclusion of a worked example should also be considered for the same reasons (Clark & Mayer, 2008).

3. To develop new scenarios to be released as the year progresses, as suggested by the 2010 – 2011 trainees.

4. To develop an enhanced monitoring function for NES staff so that they can investigate low usage and offer support to trainees who appear to be struggling with the program. This was suggested by trainees in the learning needs analysis study.

Given that the student feedback on SCRIPT was obtained through a questionnaire, there were a number of responses that would have benefited from further clarification perhaps through qualitative methods. As such it would be valuable to recruit trainees to help develop SCRIPT and to test any changes that are made before releasing to a full training cohort.

Research opportunities

Before SCRIPT is developed further as an accuracy checking resource there should be an investigation into the stage at which accuracy checking should be covered in the undergraduate or pre-registration curriculum. James *et al* (2010) highlight the importance of incorporating accuracy checking in pharmacist education but is not clear at which stage this is most appropriate and it is not clear if or how SCRIPT could be used as a support tool. One suggestion is to use SCRIPT for part task practice, in relation to the principles of the 4C/ID instruction design model (van

Merriënboer *et al,* 2002), to support the overarching skill of prescription assessment.

Further qualitative research should be considered to determine the most suitable version of SCRIPT to support pre-registration training. This might not be restricted to accuracy checking and may require additional scenarios to be created and released as the trainees progress through the year as was suggested by the trainees in the learning needs analysis stage of this study.

Whatever developments are made, ultimately behaviour or results based evaluations should be considered to determine the effect of SCRIPT on actual practice. However, Maxwell & Mucklow (2012) warn that such evaluations may be time consuming, costly, and complicated due to confounding factors. There is also a need to identify objective measures, for example the number of errors that are identified or prevented in the workplace and a means to capture these before the study commences (Kirkpatrick, 1994). As such analysis of trainee's use and perceptions should be ongoing to measure trainee engagement with SCRIPT because engagement is required before behaviour or results based changes can occur (Kirkpatrick, 1994). However, as a first step, the role of SCRIPT as a support to the pre-registration curriculum has to be determined before developments and evaluation can be planned.

Chapter 5

Conclusion

5.1 Overall conclusions and recommendations for future work

This thesis describes the development and evaluation of SCRIPT over four years. In 2007 – 2008 SCRIPT was evaluated as a supplemental revision resource for pharmacy students undertaking a competency based practice class. Student use was determined by analysing SCRIPT use data and student perceptions were determined by through an online questionnaire. Staff perceptions were also determine through unstructured interviews. This analysis revealed that students had made considerable use of SCRIPT, throughout the day and mainly around the time of assessments. There were a number of developmental needs identified in this study including: rationalisation and clarification of the error descriptions, enhancing error selection, aligning SCRIPT to the competency based class, increasing the number of scenarios, enhancing the feedback in the scenarios, improving functionality for staff and developing staff and student instructions. Each of these developments were undertaken in preparation for the 2008 – 2009 academic year. This was achievable because scenarios were being added to an unpublished version of SCRIPT throughout the year. Anecdotal feedback allowed pre-emption of the error code review and instructions were a logical addition so these were in development before the questionnaire had closed.

The 2008 – 2009 and the 2009 – 2010 evaluation allowed comparison of two different integration strategies. There was no clear evidence in the literature to inform of the most important strategy for integration of this type of resource, so this study adds to a growing body of research (Cook *et al*, 2008). The student log-in data provided evidence that different integration approaches can affect the number of log-ins made by students in their own time, with a reduction observed after SCRIPT was made available during class teaching. However the qualitative interviews indicated that there are a number of different approaches that students adopted when using SCRIPT: including group access. There was no statistically significant difference between the cohorts in terms of class success. This outcome is

consistent with current e-learning research (Chumley-Jones *et al*, 2002; Bernard *et al*, 2004; Cook et al 2008; Bernard *et al*, 2009).

Although students from the Supplemental cohort were asked to participate in semi-structured interviews to help understand their experience of SCRIPT, no students responded to this request despite various reminders. This prompted a different approach to obtaining the perspective of the Replacement cohort: using their peer group to conduct the interviews. This resulted in data that could be analysed, which was enlightening in terms of student use and perceptions. The students were able to describe their approach to using SCRIPT and perhaps the most revealing aspect of this study was the value placed on face to face group working while using SCRIPT. This follows a constructivist approach to learning and suggests that online technology does not always have to be delivered at a distance and future research may help determine what degree of blended learning is most appropriate and if different student types benefit from different approaches.

In the 2010 – 2011 academic year, pre-registration trainee views were sought to determine if an e-learning program would be valued to support pre-registration training, and what topics should be a priority from a trainee perspective. This was conducted first through an e-learning questionnaire and then through a telephone focus group. It was clear from the questionnaire and focus group that calculations, accuracy checking and minor ailments were considered a priority by trainees. Given the nature of the existing SCRIPT technology and the fact that there was no alternative support available, SCRIPT was adapted to as an accuracy checking support tool. This was piloted in the 2011 – 2012 academic year and there was moderate uptake from pre-registration trainees. The return rate of the evaluation questionnaire was low and the feedback about SCRIPT was mixed. Although an instruction manual was available and SCRIPT was highlighted as a key resource, there was no formal introduction to SCRIPT and integration in to the pre-registration training programme could have been better. However, there were

some valuable suggestions made by the trainees which will inform program development: in particular to reassess the stage in which an accuracy checking resource should be made available.

As with current literature, the outcomes associated with learning were very difficult to determine because of the relatively small numbers in each cohort and a large number of confounding factors (Ellaway, 2010). This limits the ability to conduct a higher level evaluation, which could identify changes in behaviour or practice.

The studies in this thesis identified that students had different learning needs and styles, which resulted in different preferences for the use of SCRIPT. Future developments may benefit from reviewing pharmacy education, from entry to university to registration, to identify what should be covered when. A curriculum could be created following the principles of the Emporium or Buffet models of redesign (Twigg, 2003) to allow greater flexibility to meet individual student's needs (Cook, 2012). However, students would have to develop self directed learning and reflection skills to enable them to identify their weaknesses and identify the best resources to suit their needs (Schön, 1987; Knowles *et al*, 1998).

Throughout these studies care was taken to ensure the methods used were aligned to the development and evaluation of SCRIPT rather than claiming to be a wider hermeneutic / anthropological study of student behaviour. The behavioural analysis from log file data was conducted as an indication of user acceptance and to give the SCRIPT editorial team an idea of usage pattern to determine how SCRIPT complemented existing resources. This study was limited to the context of SCRIPT use in pharmacy education and as such the findings will have low generalisability to other e-learning resources or student groups. This is a common issue associated with e-learning research (Bluic *et al*, 2007; Wong *et al*, 2012). During this study the developers licensed SCRIPT and it is now used in a number of institutes UK wide. Future research would benefit from comparing the experiences of students and

staff in each of these institutes to allow for greater generalisability of the findings. A case study approach would allow the developers to understand how SCRIPT is used and experiences in different institutes but this may not increase generalisability of the findings (Bluic *et al*, 2007).

Alternatively a realist approach, which is increasing in popularity within educational programme evaluation, may help identify what works for whom and in what circumstances (Pawson, 2002; Wong *et al,* 2010; Wong *et al*, 2012). Realist evaluation takes account of the context, mechanisms and outcomes of an educational programme and aims to identify what works and what does not work so that programmes can be adapted to increase the likelihood of positive outcomes. Realist evaluations contain qualitative and quantitative methods which may be adapted during the study period to "*help confirm, refute or refine emerging programme theories*" (Wong *et al*, 2012, p93). The aim of this approach is to develop a middle range theory that can be applied to a wide context and may be amended on an iterative basis guided by future research. Conducting such research on the use and perceptions of SCRIPT across various institutes may help identify the most appropriate way to integrate SCRIPT, or e-learning in general, into pharmacy curricula.

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Appendices

Appendix 1.1 Marking guide for the competency based class assessments

Consistency of marking is an important issue for students and staff. The following minimal guidance is the basis of the Strathclyde Institute of Pharmacy and Biomedical Sciences marking structure for [the competency based class]. The assessment for this subject is a "competency" based exam. The calculation of the mark is based on the attached criteria, which reflects areas of competence required in the dispensing process. The pass mark for this assessment is 50% and marks are deducted accordingly. Similar marking schemes that use deduction of marks are used in the majority of the universities that teach the pharmacy degree.

%	Descriptor
90 - 100 80 - 89	Truly exceptional/Outstanding demonstration of learning outcomes • Wide, appropriate knowledge and understanding including insight and / or originality • Evidence of reading and thought beyond course materials • Appropriate use of references • A high standard of writing and communication • Consistent demonstration of the competencies required in the dispensing process • Safe, effective, appropriate and legal supply
70 - 79	Excellent demonstration of learning outcomes • Wide, appropriate knowledge and understanding including insight and / or originality • Evidence of reading and thought beyond course materials • Appropriate use of references • A high standard of writing and communication • Consistent demonstration of the competencies required in the dispensing process • Safe, effective, appropriate and legal supply
60 -69	Comprehensively Good demonstration of learning outcomes • Wide, appropriate knowledge and understanding • Evidence of reading and thought beyond course materials • A high standard of writing and communication • Demonstration of the competencies required in the dispensing process • Safe, effective, appropriate and legal supply
50 - 59	Satisfactory Good demonstration of learning outcomes • Sound knowledge and understanding of essential material • General accuracy with occasional mistakes and / or uncoordinated use of information • Safe, effective, appropriate and legal supply
0 - 49	Unsatisfactory demonstration of learning outcomes exhibiting one of the following • Overdose • Life threatening interaction • Dispensing error • Illegal supply • Accumulation of errors

Below 0	Unsatisfactory demonstration of learning outcomes exhibiting more than one of the following • Overdose • Life threatening interaction • Dispensing error • Illegal supply • Accumulation of errors

This is done on a negative marking scale, *i.e*. students start with 100% and lose marks for errors incurred depending on severity (please refer to Marking Guide and Criteria for Marking).

Criteria for marking [the competency based class assessments]

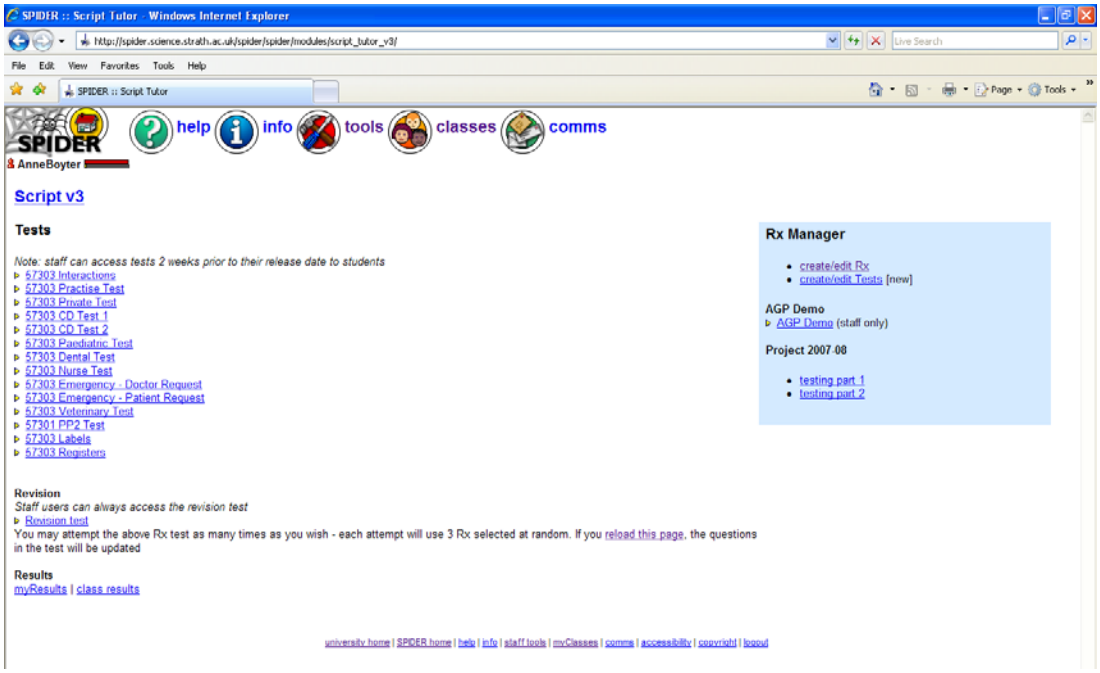
The list is not exhaustive but gives an indication of what is expected.

Reason	***Explanation***	***Deductions***
Overdose/failure to check dose		Up to -100
Life threatening interaction		Up to -100
Incompletion of prescription i.e. part or no dispensing of requested item		-30 to -60
Dispensing error	e.g. wrong drug supplied	-60
Labelling a bottle of water with drug name		Up to -100
Illegal supply of POMs		-60
Supply of wrong quantity		-60 for CDs -10 for other
Labelling error		If leads to O/D up to -100 Up to -30
Inappropriate clinical decision (if not life threatening)		-20 to –30
Inappropriate response to drug interaction	e.g. “monitoring” if this is not feasible in community practice	-20
Counselling using suitable language	This includes name and address check, dosage instructions, side effects if appropriate	up to –20
Register entries	if produce one that is not necessary if wrong reason *i.e.* good professional practice or legal if miss controlled drug if miss POM	-10 -5 -20 -10
Legal category	if incorrect	-5
Intended use	if inappropriate indication based on available information	-5
Inappropriate Prescriber consultations	For each attempt	-5
Failure to check expiry date		-5

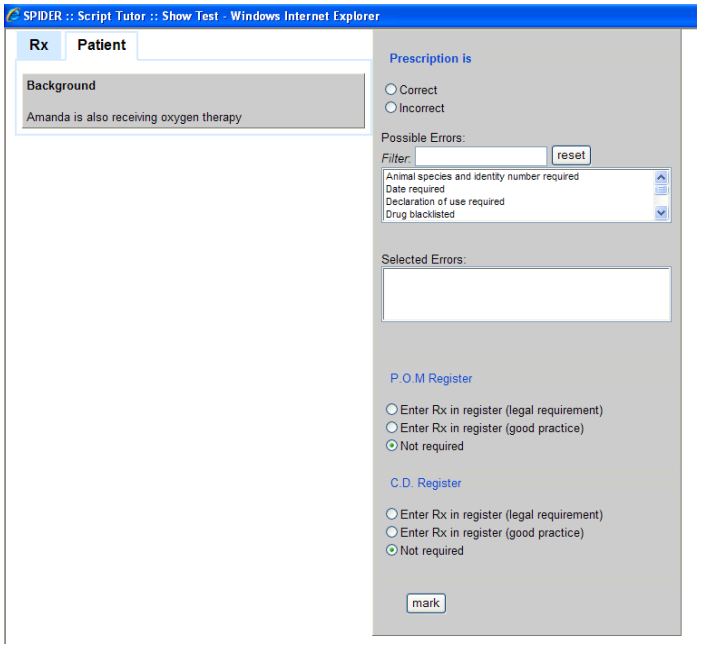
Appendix 1.2 SCRIPT student instructions (version 5.0)

Instructions for SCRIPT

From the PP3 home page on SPIDER you can enter SCRIPT using the SCRIPT tutor link. You should then enter one of the topics. These topics will be released to match the teaching in the class. When you enter a topic you will be presented with groups of 3 prescriptions in a random order.



For each scenario there is also additional information which may or may not be relevant. This can be viewed by clicking the additional tabs at the top of the screen.



For each prescription you need to complete 3 tasks.

1. **Decide if the prescription, label or register is "Correct" or "Incorrect" and check as appropriate. Where you are attempting a label or register example the prescription will always be legally correct. In this scenario, you will have to determine whether the label/register entry for that prescription is appropriate and complies with legislation.**

If you think that the prescription, label or register is "Incorrect" you must then choose one or more item from the drop down menu. There is a filter box above the list of possible errors. By typing part of the error in this box you will limit the number of errors you can see, making it easier to find the error you are looking for. For example, if a signature is missing from a prescription and you type "signature" in the filter box, only errors that contain the word "signature" in the description will be shown.

To select an error double click on the drop down menu and the error will appear in the "selected errors" box.

You can choose as many errors as you like for each prescription.

To remove any accidentally selected errors, double click on the error within the "selected errors" box.

If you are completing the exercises relating to labels or registers the prescription will always be legally correct and you will be checking that the label or register have been completed correctly. There are different errors for the labels and registers. These are detailed below.

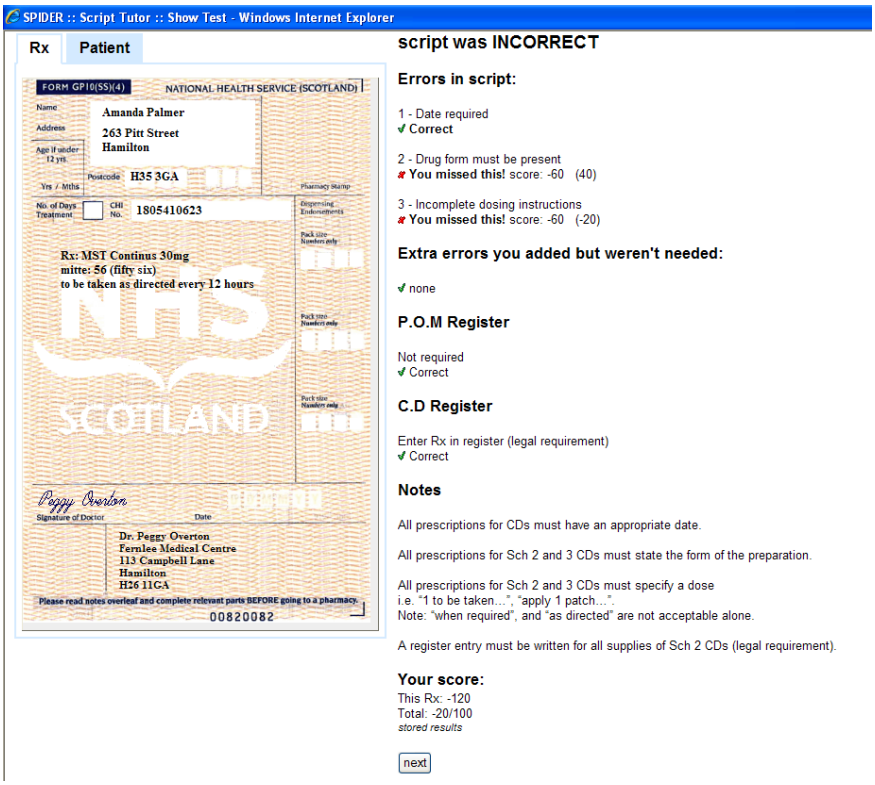
2. **Decide if the prescription needs to be registered in the prescription (POM) register**

   Choose one of the three options available

3. **Decide if the prescription needs to be registered in the controlled drug register**

   Choose one of the three options available

Once you have made your decisions click **"Mark"**. The prescription will then be marked and you will receive feedback.



Choose **"Next"** to proceed to the second and third prescriptions which you should answer as above. You should follow this process until you have completed all the prescriptions in the group of three.

At the end of each group of three prescriptions you will be given the overall mark for that test. You can also access **myResults** on the initial page which will give you feedback on all the prescriptions you have attempted. There is also a bar chart which allows you to look at all the errors you have made.

You can attempt the tutorial as many times as you like. To ensure that you get different prescriptions always refresh the page. In the revision tutorial there are over 400 examples.

You will need to refer to a variety of reference sources, such as your BNF and MEP, to complete the exercise.

Questions

If you have any queries about the answers given please direct these to script-tutor@strath.ac.uk and not the teaching staff for PP3. Queries directed here will be answered as soon as possible.

Summary of Errors

There are four different error lists; prescription; interaction; label and register errors. Only the error list that relates to the type of prescription you are assessing will be shown.

Prescription Errors

The standard errors in the programme are in an alphabetical list. This list is reproduced below with an explanation of the error:

Error	Comment
Animal species and identity number required	The animal species and / or identity number is missing and is a legal requirement for this prescription type.
Date required	There is no date on the prescription/requisition and there is a legal requirement for this to be present.
Declaration of use required	The purpose for which an item has been requested is missing. This is a legal requirement on this prescription/requisition type.
Drug blacklisted	The item on the prescription/requisition is blacklisted on the NHS and as such will not be reimbursed.
Drug form must be present	The drug form (capsule, tablet, or ampoule) is not present. It is a legal requirement for this to be present on this prescription / requisition type.
Drug strength must be present	The drug strength is not present. It is a legal requirement for this to be present on this prescription/requisition type.
Inappropriate dosing instructions	The dosage instructions are not appropriate for this patient, medicine or indication. Examples; "Adalat LA 60mg tablets Sig: 1 tablet tds Mitte: 28" These tablets are modified release and should be prescribed **once** daily. Not only are the dosage instruction inappropriate but there is an overdose as well. Both errors should be selected. "Simvastatin 40mg tablets Sig: 1 tablet mane Mitte: 28" Simvastatin should be taken at night. Therefore the dosage instructions are inappropriate for this item.
Inappropriate quantity	The quantity prescribed is inappropriate for the medicine prescribed. This may be a good practice error or a legal error.

	Example; "Prednisolone 5 mg tablets Sig: 8 tablets mane for 5 days Mitte: 28" 8 tablets for 5 days = 40 tablets in total.
Incomplete dosage instructions	Part of the dosage instructions is missing. This may be a good practice requirement or a legal requirement.
Incomplete drug name	Part of the drug name is missing. Without the complete name there is a chance that the wrong item may be dispensed.
Incomplete practitioners details	The practitioner's details are incomplete making the prescription/requisition illegal.
Incorrect drug strength	The drug strength selected is incorrect for the intended use.
More than 30 days supply ordered	More than 30 days supply has been ordered on the prescription. For this prescription item it is considered good practice to limit the supply to 30 days treatment.
Need weight to calculate the dose	The weight of the patient/animal is missing and therefore an accurate dose check cannot be made.
Overdose	The dose prescribed exceeds the manufacturer's maximum recommended dose for the patient / animal.
Patients age required	The patient's age is missing and is required for an accurate dose check and/or a legal prescription.
Potential interaction requiring pharmacist counselling	There is a potential interaction but the prescription does not need to be amended as long as the pharmacist counsels the patient appropriately.
Practitioners signature required	There is no signature on the prescription / requisition and one is required for the prescription/requisition to be valid.
Requires owners details	The details of the animal's owner are missing and are required for a legal prescription.
Requires patients full address	The patient's full address is missing and is required for the prescription to be legal.
Requires patients full name	The patient's full name is missing and is required for the prescription to be legal.
Requires to be written in generic form	The drug prescribed/requested must be written in the generic to ensure the prescription/requisition is legal and/or reimbursed.

Rx is invalid as it is more than 28 days old	The day of supply will be more than 28 days after the appropriate date on the prescription, making the prescription invalid.
Rx required to be in practitioners own handwriting	The prescription has been generated on a computer and as such is invalid.
Sub-therapeutic dose	The prescribed dose is below the manufacturer's recommended therapeutic dose for the patient/animal.
Total quantity also requires figures	The total quantity has not been given in figures, which is a legal requirement for this prescription.
Total quantity also requires words.	The total quantity has not been given in words, which is a legal requirement for this prescription.
Total quantity required	The total quantity is missing from the prescription and this is required for a legal prescription. (Please note that if the quantity has to be written in words and figures more than one error may need to be selected) .
Unable to be prescribed for this indication by this prescriber	The item cannot be supplied for the intended indication. That is, the condition being treated makes the supplied invalid (e.g. a nurse, without an independent prescribing qualification, prescribing an item with a POM indication).
Unable to be prescribed on this form by this prescriber	This type of prescriber (dentist/nurse/vet etc) cannot prescribe this particular item on this type of form. This prescriber may be able to prescribe this item on an alternative form type (e.g. a private form)
Unable to supply to this person	The person requesting the item is not legally entitled to make this request. They do not have authority to request this item or the relevant paper work to make the request. Supplying the item would be illegal.
Wrong drug may have been prescribed – check with the prescriber	The prescriber may have prescribed the wrong item and must be contacted to verify this.

Interaction Errors

The interaction errors in the programme are in an alphabetical list. More than one error code may be correct for any interaction, as there may be more than one way to resolve that interaction. The programme will mark either error correct and feedback will be supplied. Medication A will always refer to the first item on the prescription; medication B may be the second medication or the first one mentioned in the patient information. Medication C is the first medication on the information if there are two items on the prescription. This list is reproduced below:

Error	Comment
No interaction	There is no clinically significant interaction between any of the medicines.
Interaction which requires a change in medication A	There is a clinically significant interaction which requires the first item on the prescription to be changed.
Interaction which requires a change in medication B	There is a clinically significant interaction which requires the second item on the prescription (or the item in additional information) to be changed.
Interaction which requires a change in medication C	There is a clinically significant interaction which requires the third item on the prescription (or the item in the additional patient information) to be changed.
Interaction which requires an increase in the dose of medication A	There is a clinically significant interaction which requires the dose of the first item on the prescription to be increased.
Interaction which requires an increase in the dose of medication B	There is a clinically significant interaction which requires the dose of the second item on the prescription (or the item in additional information) to be increased.
Interaction which requires an increase in the dose of medication C	There is a clinically significant interaction which requires the dose of the third item on the prescription (or the item in the additional patient information) to be increased.
Interaction which requires a decrease in the dose of medication A	There is a clinically significant interaction which requires the first item on the prescription to be decreased.
Interaction which requires a decrease in the dose of medication B	There is a clinically significant interaction which requires the second item on the prescription (or the item in additional information) to be decreased.
Interaction which requires a decrease in the dose of medication C	There is a clinically significant interaction which requires the third item on the prescription (or the item in the additional patient information) to be decreased.
Interaction which requires patient monitoring	There is a clinically significant interaction which can be managed by monitoring the patient without changing any of the medication.

Interaction intended for therapeutic effect	There is a clinically significant interaction but this is intended for the therapeutic effect.
Potential interaction requiring pharmacist counselling	There is a potential interaction but no medication needs to be altered if the pharmacist counsels the patient appropriately.

Label Errors

The label errors in the programme are in an alphabetical list. This list is reproduced below:

Error	Comment
Additional cautionary and/ or advisory warning label not required	One or more cautionary and / or advisory messages are on the label and are not required.
Cautionary and/ or advisory warning label missing	One or more cautionary and / or advisory messages are missing from the label.
Date of dispensing missing	The date of dispensing is missing from the label.
Directions incorrect	The directions on the label are not correct; they do not match those on the prescription.
Drug name incorrect	The drug name on the label is not correct: is not the same as the one on the prescription.
Drug name missing	The drug name is missing from the label.
Drug form incorrect	The drug form on the label is not correct: it is not the same as the one on the prescription.
Drug strength incorrect	The drug strength on the label is incorrect: it is not the same as the strength on the prescription.
"Emergency supply" missing	The phrase "emergency supply" is not on the label and is required to make the supply legal.
Patient name incorrect	The patient's name on the label is incorrect: it is not the same the name on the prescription.
Patient name missing	The patient's name is missing from the label.
Pharmacy details missing	The pharmacy details are missing from the label.
Quantity incorrect	The quantity on the label is incorrect: it is different than the quantity on the prescription.
Reference number for private prescription missing	The reference number for a private prescription is missing from the label and is required to make the supply legal.

Register Errors

The register errors in the programme are in an alphabetical list. This list is reproduced below:

Error	Comment
Patient's details missing	The patient's details are missing from the register entry and they are required for a legal entry.
Patient's details incorrect	The patient's details that are entered in the register are incorrect: they do not match the details on the prescription.
Date dispensed incorrect	The date entered in the register is not the date that the product was dispensed and supplied to the patient.
Date dispensed required	No date has been entered in the register and it is required to make the entry legal.
Incomplete practitioner's details	The practitioner's details have not been entered fully in the register and must be completed for a legal entry.
Practitioner's details required	The practitioner's details are missing from the entry and they must be present for a legal entry.
Practitioner's details incorrect	The practitioner's details in the register are incorrect: they do not match the details on the prescription.
Name of drug required	The drug name is missing from the register and is required for a legal entry.
Name of drug incorrect	The drug name in the register is incorrect: it is different to the drug name on the prescription.
Quantity required	The quantity supplied is missing from the register and is required for a legal entry.
Quantity incorrect	The quantity entered in the register is incorrect: it does not match the quantity on the prescription.
Form required	The form is missing from the register and is required for a legal entry.
Form incorrect	The form entered in the register is incorrect: it is different from the form on the prescription.
Strength required	The strength is missing from the register and is required for a legal entry.
Strength incorrect	The strength entered in the register is incorrect: it is different from the strength on the prescription.
Dose is required	The dose is missing from the register and is required for good practice.

Dose is incorrect	The dose entered in the register is incorrect: it is different from the dose on the prescription.
Details of representative required	The detail of the patient's representative is missing from the register and is required for a legal entry.
Details of representative incorrect	The details of the representative are incorrect: they do not match the information of the scenario.
Class of drug required	The class of drug is missing from the register and is required for a legal entry.
Entered in the incorrect class of drug	The CD entry has been made in the wrong class of drug (for example Oxycontin® registered under the morphine section).
Running balance is required	The running balance is missing from the register and is required for good practice.
Running balance is incorrect	The running balance is incorrect: the calculation is wrong.
Entered in the incorrect page of the CD register	The entry has been made in the wrong page of the CD register, either in the wrong drug name, strength, or form.

Appendix 2.1 Student SCRIPT questionnaire

	Strongly agree	Agree	Neutral	Disagree	Strongly disagree
The tutorial was easy to access					
The instructions for this tutorial were easy to follow					
The tutorial was helpful in identifying problem areas					
The prescriptions were similar to the ones seen in [the competency based class]					
The drop down menu was clear and easy to understand					
The feedback given in the tutorial was helpful					
The prescriptions in this tutorial were more difficult than those seen in the [competency based class] lab					
I used SCRIPT for [competency based class] revision					
I would like this tutorial to be expanded to include other types of prescriptions					

Have you worked in community pharmacy?

Yes
No

When were you taught [the competency based class]?

Over 2 semesters
In the summer semester

When did you pass [the competency based class]?

Exemption exam
Degree exam
Resit exam
Still to pass [the competency based class]

Did you use the prescription tutor when you were studying [competency based class]?

Yes
No

Are you

Male
Female

Comments

Appendix 3.1 Student interview questions

SCRIPT is the online prescription simulation programme that allows students to identify clinical and legal errors. It was created in 2005 for use to support [the competency based class] and has been evaluated and developed each year. In 2010 – 2011 SCRIPT was available for use in the lab and all students had access to it for a 30 minute period each week. It was also available for students enrolled on the [competency based class] to use outwith class time.

Aim:

To determine students' views about how and why they chose to use SCRIPT during the 2010/11 academic year.

Objectives:

- To identify how students used SCRIPT in class and remotely in their own time.
- To determine if anything influenced students to use it in their chosen manner outwith the class.
- To identify their opinions about SCRIPT in general and to identify any changes that students think could be made to SCRIPT.

In relation to the use of SCRIPT both in class and in your own time, which will be referred to as remote access.

Q1. When did you start the MPharm degree at University of Strathclyde?

Q2. How much experience of working in community pharmacy in the UK do you have?

These questions are about your use of SCRIPT in class only, so please describe how you used SCRIPT in the lab.

Q3. How much of the thirty minutes did you usually use? Were you happy with that amount of time allocated to SCRIPT use?

Q4. How many examples did you work through during each lab session?

Q5. Did you use it alone or in groups or pairs?

Q6. How did you decide which topics to access?

Q7. Do you think your use changed or remained constant week on week?

Q8. What sources of help were available in the class? Did you use the staff for help?

Q9. Did you ever use the email helpline? Did you know about it? If you'd known about it, do you think you would have used it?

Q10. Did you ever ask other students for help?

The next section is about outwith the class, so when answering these just think about your use of SCRIPT outside the lab only.

Q11. Can you describe how you used SCRIPT outwith timetabled classes?

Q12. Did you use it alone or in groups?

Q13. How did you decide what topics to access?

Q14. What time of day did you usually use it?

Q15. Where did you access SCRIPT?

Q16. Did anything prompt you to use SCRIPT at particular times of the year?

Q17. SCRIPT was available to use both in class and also as remote access. If it had only been available to use in your own time, do you think the way you used SCRIPT would have differed?

Q18. What you think about SCRIPT in general

Q19. Did you find SCRIPT helpful for [the competency based class]?

Q20 Are there any changes that should be made to SCRIPT?

Q21 Would your use of SCRIPT have differed if you had had more or less community pharmacy experience?

Q22. Is there anything else you would like to add?

Appendix 3.2 Staff interviews

Strathclyde Customised Randomised Interactive Prescription Tutor (SCRIPT) has been developed over the last 6 years. It was originally designed as a tool to help students with revision for [the competency based class] as this was seen as an area in which there was little outside help for the students. SCRIPT was developed with help and feedback from undergraduate students and staff. For the first 3 – 4 years of development SCRIPT was used only as a revision aid with students able to log in when they wanted to and it was not linked to any teaching events.

Until and including academic year 2007/08, all students who were enrolled on the [the competency based class] had remote access to SCRIPT for their personal revision. Student use and perceptions were evaluated over these years and a number of refinements were made.

In the academic year 2008/09, prescription scenarios were grouped into tests such as controlled drugs, private prescriptions, and emergency supplies and thus aligned to the taught topics of [the competency based class]. The tests were then released for remote access to coincide with the teaching in the practical classes.

In the academic year 2009/10, SCRIPT was integrated into class teaching, replacing one member of academic staff in each practical lesson. All students had access to the tests aligned to the teaching for that particular lab for a 30 minute period during each practical session, and also as remote access for the rest of the year.

Aims:
To evaluate staff perception of SCRIPT when aligned and integrated into [the competency based class].

Objectives

- To identify the staff's awareness of how students used SCRIPT during teaching and during personal study time.
- To determine what staff thought of the way that SCRIPT was aligned to [the competency based class] teaching.
- To determine what staff thought about the way that SCRIPT was integrated into [the competency based class] teaching.
- To identify what changes that staff think could be made to SCRIPT

Discussion questions:
Q1. How do you think that students accessed SCRIPT when it was only available as a revision tool?

Q2. Do you think that this changed when SCRIPT was integrated into teaching sessions? If so, how?

Q3. Do you think there were differences between the home, including 2+2, and the collaborative cohorts?

Q4. In academic session 2008/09 SCRIPT tests were released to coincide with teaching.

a) Do you think that this changed the way students used SCRIPT?
b) Do you think that this improved accessibility of SCRIPT to students?
c) Did you notice any other changes in SCRIPT at this time?

At that time tailored feedback was added to each example:

d) Do you think that improved the student experience?

Q5. In session 2009/10 SCRIPT was integrated into the [the competency based class] labs and replaced an example lead by a member of staff.

a) Do you think that this changed the way that students used SCRIPT outwith teaching time?
b) Do you think that the integration has changed teaching in any way?
c) Do you think that the integration has changed the teaching experience in any way?

Q6.Are there any changes to SCRIPT that you would like to suggest?

Appendix 4.1 Pre-reg trainee e-learning needs analysis questionnaire

Staff in the School of Pharmacy at the University of Strathclyde have developed a bespoke, simulation program, SCRIPT (Strathclyde Computerised Randomised Interactive Prescription Tutor) to help undergraduate students revise for the competency based pharmacy practice class. SCRIPT has been evaluated and refined over the past five years and it is our intention to develop it further to integrate this tool and e-learning into the Pharmacy pre-registration year. NES, in collaboration with the University of Strathclyde, are keen to identify if pharmacy pre-registration trainees have a desire for access to an e-learning program to help further prepare them for practice as a pharmacist. To help with our development we would like your feedback and by completing this short questionnaire we hope to have a trial program up and running in Spring 2011.

Your identity will be hidden.

1) An e-learning resource would be,

	Strongly agree	**Agree**	**Neutral**	**Disagree**	**Strongly disagree**
a) helpful in my preparation for the pre-registration assessment					
b) useful in my preparation for practice as a registered pharmacist					

2) Did you use SCRIPT as an undergraduate?

- Yes
- No

3) If you have used SCRIPT before, do you think that it could be developed to be of use to you in your pre-registration?

- Yes
- No
- Maybe

4) Which of the following topics would you most like to be the focus of our development (please indicate your 1st to 5th preference)?

Topic	**Preference**				
	1st	**2nd**	**3rd**	**4th**	**5th**
Responding to minor ailments					
Delivering the Minor Ailment Service					
Care planning					
Delivering the Chronic Medication Service					
Practising accuracy checking					
Drug tariff					
Prescribing					
Calculations					
More examples of the current format					
Other (please explain in the comments and suggestions section)					

5) Do you have any comments or suggestions?

6) In which sector do you work?
- Community
- Hospital

7) From which university did you graduate?
- The Robert Gordon University
- The University of Strathclyde
- Other

8) Are you Male or Female?
- Male
- Female

Appendix 4.2 Trainee focus group

Aims:
To develop an e-learning program and introduce this into the pre-registration year in Scotland.

Objectives

- To identify the trainees' preferences of topic for e-learning and the rationale for these preferences (and determine the level of agreement with the December questionnaire results)
- To identify the key features that the program must have to ensure trainee acceptability
- To describe how the trainees envisage themselves using the program during their pre-registration year
- To identify any barriers that trainees perceive may reduce the use of the program

Introduction
NES, in collaboration with the University of Strathclyde, are keen to develop an e-learning program to help pre-registration trainees prepare for practice as pharmacist.

The University of Strathclyde have an existing simulation program, SCRIPT (Strathclyde Computerised Randomised Interactive Prescription Tutor) which was developed to help undergraduate students revise for the competency based practice class. SCRIPT has been evaluated and developed over the past three years and it's our intention to develop it further to allow integration into pre-registration.

The purpose of this focus group it to determine what pre-registration trainees' perceive to be core topics to be delivered by e-learning format, how an e-learning program should look and function to deliver this learning, whether assessment should be a part of the program, and if there are any perceived barriers to use of this program.

Q1. What do you consider to be the key priority topics to cover in an e-learning program for the pre-registration year?

- Why do you consider these as a priority?
- Do you think e-learning is a suitable means to deliver this education?
- The three most popular topics suggested by the semi-structured questionnaire were accuracy checking, calculations and minor ailments. What are your thoughts on this?
- Now you have completed more of your pre-registration training, are these still your priorities?

If there are more than one key topic each one should explored individually in the following questions.

Q2. How would you like the program to look?

- What features / functions does it require?
- What would make you, personally, log in and use the program?

Q3 How should the program be introduced to the trainees?

- When in the year should it be made available?
- Should only one version be available or should new questions be available every say 3 months, increasing in difficulty as the year progresses?
- What are your thoughts on making it compulsory?

Q4 How much time would you anticipate yourself using such a program?

- Why this pattern of use?

Q5 Should it have a scoring system?

- What should this look like?
- What are your thoughts on the feedback that the program should supply in terms of performance?

Q6 What are your thoughts on using the program as an assessment?

- Should it be used as a formal assessment or purely to help identify your individual strengths and weaknesses?
- Would you use this programme as revision before the pre-registration exam?
- Would you prefer two options- a revision option and then an assessment?
- How many scenarios should be considered in an assessment?
- What do you think of NES monitoring your use

Q7. What do you see as limitations to using such a program?

- Are there any barriers we need to consider?
- What training do you think trainees would require before using this program?

Appendix 4.3 SCRIPT Trainee evaluation questionnaire

In the pre-registration year 2010 – 2011, NES, in collaboration with the University of Strathclyde, asked pre-registration trainees to highlight what areas of their development they would like to be supported by an e-learning program. One area identified by this cohort of trainees was accuracy checking.

In response to this needs assessment the University of Strathclyde have enhanced their online prescription simulation program, SCRIPT (Strathclyde Computerise Randomised Interactive Prescription Tutor), to help pre-registration trainee pharmacists practise their accuracy checking procedures in a remote, safe environment.

To help evaluate this program and to aid development we would like your feedback by completing this short questionnaire.

1. Please indicate where you are undertaking the majority of your pre-registration training (please select the most suitable option)

    - Hospital pharmacy
    - Community multiple
    - Community small chain
    - Community independent

2. Did your employer provide accuracy checking training as part of their training programme?

Yes / no

3. How often have you made use of the SCRIPT accuracy checking program between 1st December 2010 and 1st March 2012?

    - 0
    - 1
    - 2 – 4
    - 5 – 10
    - > 10

Comment	**Level of agreement** **strongly agree**	**neutral**	**disagree**	**strongly disagree**
4. SCRIPT was helpful during pre-registration training. 5. SCRIPT was useful preparation for practice as a registered pharmacist 6. SCRIPT increased my confidence in accuracy checking labels. 7. I would use SCRIPT once I am a registered pharmacist 8. The technology underpinning the SCRIPT was reliable. 9. SCRIPT was helpful in clarifying problem areas. 10. The dropdown menus in SCRIPT are confusing 11. I would prefer to use SCRIPT in a small group 12. The feedback provided in SCRIPT was helpful in clarifying problem areas 13. SCRIPT should be available to all pharmacists 14. SCRIPT should give a mark as well as feedback 15. I had difficulty using SCRIPT because of the technology. 16. I would prefer to use SCRIPT on my own				

Comment	**Level of agreement** **never**	**rarely**	**sometimes**	**often**	**always**
17. I disagreed with the marking and feedback					

18. At which University did you study?
    - Robert Gordon University
    - University of Strathclyde
    - Other

19. Are you:

    - Male
    - Female

Comments:

Publications and conference posters

Publications

Zlotos L, Kayne L, Thompson I, Kane KA & Boyter AC. 2010. A web-based tool for teaching pharmacy practice competency. *Am J Pharm Educ* **74 (2)**, Article 27.

Conference posters

Zlotos L, Thompson I & Boyter A. The Enhancement Themes conference (2013), Glasgow, UK*. Integration of e-learning into the pharmacy curriculum*.

Zlotos L, Thompson I & Boyter A. Royal Pharmaceutical Society conference (2011), Birmingham, UK. *Comparison of aligned and integrated web-based teaching in pharmacy practice.* Abstract available in: *Int J Pharm Pract* **19 (Suppl. 2)**: 38–64

Thompson ID, Kane KA, Dempster J, Kayne LR, Zlotos L & Boyter AC. Equipping our Students for a Changing Profession (2008), Royal Pharmaceutical Society of Great Britain, London, UK. *Strathclyde Customised Randomised Interactive Prescription Tutor (SCRIPT).*