Development and evaluation of computer-based self-study materials using multimedia.

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DEVELOPMENT AND EVALUATION OF COMPUTER-BASED SELF STUDY-MATERIALS USING MULTIMEDIA.

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Abstract

Advances in technology such as increased Internet access and digital multimedia provide opportunities for developing innovative teaching and learning materials. Learning theory supports the use of computer based learning materials in providing flexible access to self-study materials, which can be tailored to the needs of specific courses and may appeal to students with a wide range of learning styles. There is some evidence to support the use of these technologies in facilitating learning but evaluations only apply to specific learning materials in the environment in which they were tested. Students of Health Sciences need access to clinically relevant self-study materials allowing feedback and facilitating understanding and application of knowledge. Identification of potential areas where computer-based resources can be used to support students' self-study has informed the development of three differently focussed computer-based self-study packages. The Movement Analysis, Manual Therapy and Stroke packages were developed using the assessment software Questionmark Perception and linked video clips. These packages were integrated into the modules they were designed to support and evaluated by the different groups of Health Science students taking these modules. The evaluation comprised a questionnaire to investigate students' attitudes and the use of tracking data from the Manual Therapy and Stroke packages to monitor students' activity with the packages. Students exhibited positive attitudes towards all the packages, the Stroke package format proving the most popular. Although the MSc (pre registration) physiotherapy student group found the Manual Therapy and Stroke packages beneficial they were significantly less positive towards different features of these packages. Otherwise no significant differences were found between different course groups, ages and genders of students using these packages. Analysis of the tracking data revealed significant positive correlations between the amount of times students accessed the packages and

their improvement in self-study scores for both the Manual Therapy and Stroke packages. The time spent using the packages and students' self-study scores for the Manual Therapy package were also significantly positively correlated. Correlations between student access and test score were not significant. In conclusion these packages provide appropriate and effective self-study materials for the groups of students studied. Development and updating of these and similar packages should be continued and further research is required to evaluate their effects with larger samples of students and further investigate the relationship between package use and test scores.

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Related Publications and Presentations

Cooper V. & McConnell M. (2000) *"Development of a Web-based Learning Tool for undergraduate health professionals studying applied anatomy. "*, ALT-J, vol. 8, no. 1, pp. 62-70.

Cooper, V. & Ogilvie C. (2003) *" Interactive web-based video simulation of anatomical movement analysis: development integration and Evaluation."* International Simulation and Gaming Yearbook vol.11 accompanying CD-ROM Percival F. & et al, Eds.

Cooper V. (2004) *"Using video in Health Sciences Teaching and Learning."* Networked Learning Conference proceedings April pp.38 – 44.

Cooper V. (2005) *"A patient video to facilitate self study in neurology."* Videoactive JISC Case study guide to using streamed video. JISC publications.

2004 Robert Gordon University John Gray Merit Award for innovation in teaching and learning.

Member of JISC Stream Team from 2005

Introduction

Changes in health professional education

This project has been developed to support students in physiotherapy, occupational therapy and sports and exercise science students. The term health science in this case refers to students studying in the School of Health Sciences at the Robert Gordon University, including diagnostic radiography, and its use is extended to include courses of this nature conducted elsewhere. The term health professional is used to refer to the professions represented by the Health Professions Council, which does not include Sports and Exercise Scientists.

The education of health professionals has undergone significant changes over the last twenty years. In the past physiotherapy and occupational therapy courses were taught in hospital based schools, in a model similar to that of nurse training. A national syllabus was dictated by the Chartered Society of Physiotherapy and students sat national examinations. Schools had small numbers of students and a high student / staff ratio. Although teaching was mainly didactic and classroom based there was a large practical element. The percentage of teaching time spent in contact with students was high as schools operated with few vacations and terms rather than semesters. Less emphasis was therefore placed on directed and self study activities other than revision. Physiotherapy and Occupational Therapy students require to undergo a minimum of 1000 hours of clinical education, which usually takes the form of work based placements in four to six week blocks in different clinical areas. It is important that students have a variety of placements, which they are required to prepare and

study for. Clinical placements were undertaken usually within local hospitals and therefore could be either part-time, with students returning to school in the afternoon, or full-time.

In 1990 there was widespread validation of physiotherapy degrees by higher education establishments; curriculum changes also took place which brought a shift away from the prescriptive national syllabus to an indicative guide to course content in line with the Chartered Society of Physiotherapy's requirements. By the end of 1993 physiotherapy had become an all-degree-entry profession (Barclay 1994). Occupational Therapy education followed a similar route and in 1991 the first combined occupational therapy and physiotherapy school was started at the University of East Anglia (Barclay 1994). The change to university education was seen is a very important positive step for allied health professionals such as physiotherapists, occupational therapists and diagnostic radiographers. Palastanga (1990) postulates that the move to this type of higher education will empower physiotherapy graduates with the knowledge and skills required to become critical thinkers and thus carry out research to improve the evidence-base underpinning the physiotherapy profession.

Adapting to university teaching has been challenging for educators of health professionals. Courses have evolved to include professional issues and research components. Clinical placements are usually full time and students may have to travel and stay a significant distance from the university. These developments along with increasing student numbers and effects on the timetable inflicted by semesterisation have necessitated changes in the delivery of teaching and learning to achieve the

desired learning outcomes. Educators can no longer continue to teach their students in the ways that they themselves were taught but must use innovative strategies to overcome limited contact time while fostering more student-centred learning approaches consistent with university education.

Changes in technology

The last decade has seen major advances in computer based technologies. These technologies have also become much more widely available and accessible in terms of cost and ease of use. In particular, access to the Internet has vastly increased, and with the advent of broadband, become much faster. Many universities have invested substantial amounts of money and resources in upgrading their computer systems and developing their internal web-sites to provide virtual leaning environments. Unfortunately, as Ayers & Grisham (2003) comment despite the amount of technology available the vast majority of teaching and learning proceeds as it has for generations; isolated and sometimes insulated from the powerful networks we use in the rest of our everyday lives. Ayres & Grisham (2003) also suggest that those who have done the most to enhance the use of technology are librarians who have revolutionised the management of information. Another area of education embracing these new technologies is distance learning. Much of the pedagogical research conducted in relation to computer based or assisted learning, or e-learning as it is more recently described, has been conducted in the distance learning environment. Campus based courses have been slow to adapt their teaching and learning to make use of these technologies. Milliken & Barnes (2002) illustrate this with a quote from Ruth (1997 p.1) who remarked "while a medical doctor from the previous century

would not recognise the technology in today's hospital, a college professor from that era, would see virtually no change in the tools of education."

There is a danger that pressure on lecturers to make use of these expensive materials will lead to their incorporation into learning without sound pedagogical underpinning. Conole & Oliver (1999) designed a pedagogic toolkit for embedding the use of computer and information technology into the curriculum. They suggest the following steps are taken when considering restructuring a course or module:

1. Review the existing course to identify strengths and weaknesses
2. Identify suitable teaching media
3. Use an elimination table to select the most appropriate teaching media for the course considering preparation time, flexibility of delivery, educational interactions and local factors affecting media use.

These suggestions illustrate the need to use technology with specific learning requirements in mind and in a way that will hopefully improve the learning experience. This project arose from the identification of weaknesses in particular learning situations. Video technology was identified as a means of providing students improved opportunities to visualise required course materials. It was also important that students were able to interact with these videos in various ways and to receive feedback on these interactions. At the start of the project technology was beginning to be developed which would facilitate the accessibility of interactive video clips and over the course of the development and evaluation of these new learning materials significant advances in this technology were made. This thesis therefore describes the development and evaluation of computer assisted materials in relation to the learning

needs and outcomes they were required to address and how this evolved as the technology advanced.

Plan of thesis

Chapter 1

The first chapter is a review of the relevant literature and begins by presenting the underpinning educational theories relevant to health professional students in higher education. The relationship between students' learning styles, preferences and attitudes towards computers and e-learning is then examined. The last section reviews research into the use and evaluation of e-learning in health related courses. The chapter ends with a summary and describes the aims and objectives of the project.

Chapter 2

This chapter describes the development and evaluation of three computer based learning packages designed to supplement different modules in courses for health professionals. These are described in the order they were developed: the Movement Analysis package and pilot study, the Manual Therapy package and the Stroke package. The development and evaluation objectives specific to each package are presented.

Chapter 3

This chapter presents the results of the package evaluations. It is divided into four sections. The results of each package are discussed sequentially and the fourth section presents the findings of the comparison of the three packages.

Chapter 4

This final chapter discusses the findings in relation to key findings, strengths and weaknesses of the project and future developments and implications for teaching and

learning in this area. The chapter ends with a summary of conclusions drawn from the findings and this discussion.

Chapter 1 Literature Review

Introduction

A literature search of the following databases was carried out ERIC, MEDLINE, CINHAL, Science Direct and Ingenta. Keywords used were education, learning, computers, e-learning, computer-based learning, health sciences, health, students, physiotherapy, occupational therapy, sports science, professional allied to medicine, health professionals, higher education, adult learners, learning theory, evaluation, development, integration. The key words were combined using Boolean operators and/or. Articles were chosen which had direct relevance to the study and restricted to those written in the last 15 years excepting those who were deemed highly relevant or key to their field of knowledge. Availability of an English translation was also necessary and an attempt was made to restrict journal publications to those that were peer reviewed.

The literature reviewed will be discussed by first describing the theories of learning underpinning higher education. Theories relating directly to best practice in e-learning are relatively new in their development and tend to relate mostly to distance and open learning. Learning theories, however, should be used to underpin the rationale for the development of all instructional design whether classroom or computer based. This literature review will therefore initially consider learning theories relating to students in higher education, in particular those relating to Health Science students and the particular professional skills they are required to develop. As the aim of this project was to develop e-learning packages to facilitate self-study, the next section considers theories and previous research informing best practice in the use of technology for

self-study and assessment. The following section will discuss the relationship between learning styles, preferences and attitudes of students and computer based learning / e-learning. The final section will discuss previous research in e learning, particularly in relation to its use and evaluation within health related courses.

Learning theories relating to health science students in higher education.

The university student is generally considered an adult learner. Knowles (Knowles 1990) describes adult learners as responsible for self directing their own lives or being self directed learners. He also suggests an andragogical higher education environment providing instruction for adults, which focuses more on the process and less on the content being taught. Strategies such as case studies, role-playing, simulations, and self-evaluation should be used to facilitate self-directed learning. Instructors should adopt a role of facilitator or resource rather than lecturer or grader (Knowles 1990). In Scotland students attend university from the age of 17 and many of these students have arrived straight from school. It is difficult for many of them to make the transition from the pedagogical learning environment of school to that described by Knowles as the andragogical environment facilitated at university (Knowles 1990). This difficulty was recognised by Lawton (1996) and she suggests that students arriving at university will need guidance and support during the course to develop into an adult "andragogical" learner. Ellington & Earl (1996) suggest that at entrance to university, students adopt Piaget's formal operational stage of learning as according to this learning theory most children will have reached this level of cognitive development by the age of fifteen. The stages of learning described by Piaget represent the development of four cognitive structures: sensorimotor, preoperations,

concrete operations and formal operations which are part of the normal process of child development (Brainerd 1978). On reaching this fourth stage of formal operation one becomes capable of abstract thinking. These cognitive structures change through the processes of adaptation, assimilation and accommodation, where the cognitive structure is eventually developed to make sense of the environment. For cognitive development to take place there are constant efforts to adapt to the environment through assimilation and accommodation (Piaget 1970). The implications of this theory for those involved in designing teaching and learning experiences suggests the use of activities or situations, which will engage learners and encourage assimilation, challenge and actively involve students at their appropriate cognitive level (Brainerd 1978). Thus students at university should be challenged with activities which facilitate and further develop abstract thinking. Learners may be disadvantaged, however, if they have not yet fully developed to this level and attempts should therefore be made to identify students who are struggling with activities of a higher cognitive nature and support them at the appropriate level. For example if their ability to retain and understand basic information is poor it will be difficult for them to adapt and apply this knowledge to other situations through abstract thinking. Activities which allow students to test themselves and identify their knowledge and understanding of a subject would therefore be beneficial in identifying weaker areas which may then be addressed, either by the student themselves or with support from a tutor. Activities such as this would allow the student to be supported when necessary but also places some responsibility for identifying and responding to gaps in cognitive skills on the student as suggested by Knowles (1990).

Many of the theories relating to adult learning imply that students should indeed take responsibility for developing their own cognitive abilities. Based on the theories of Gagne, Knox (1977) believed students in higher education are capable of concept learning, acquisition of rules and problem solving. This supports Knowles'(1990) description of andragogy, which suggests that adult learners value the use of problem based approaches to learning that take their prior experience into consideration and integrate with the demands of their every day life. Bruner's (1966) constructivist learning theory also includes the themes of active learning and the construction of new ideas and concepts based on prior knowledge. This theory suggests that the learner selects and transforms information, constructs hypotheses and makes decisions relying on a cognitive structure to do so. The cognitive structures, or schema, provide meaning and organisation to experiences and allow individuals to go beyond the information given (Bruner 1966). From this theory of learning Bruner (1966) developed principles of instruction in order to facilitate learners construction of their own learning. These can be summarised as follows;

1. Instruction must be concerned with the experiences and contexts that make the student willing and able to learn.
2. Instruction must be structured so that the student can easily grasp it.
3. Instruction should be designed to facilitate extrapolation and fill in the gaps.

These principles of instruction are designed to promote the construction of new schemas of knowledge, the organisation of which contributes to the students' understanding of concepts ultimately allowing students to solve related problems. The short term or working memory, which initially processes the information taken in by the student, is limited. As the learner becomes more familiar with material and begins

to construct their own meaning (schema) it is stored in the long-term memory. Most cognitive scientists believe that the storage capacity of long term memory is unlimited (Kirschner 2002). The ability of the working memory to handle information is affected by its capacity and therefore if overloaded with more information than it can process, the formation of schemata is less likely to occur. This is known as Cognitive Load Theory (CLT) (Sweller et al 1998). The instructional implications of this theory suggest using teaching and learning methods designed to reduce working memory load and facilitate changes in long term memory associated with schema acquisition. Kirschner (2002) describes working memory load in terms of germane cognitive load. The cognitive load imposed on the learner by the characteristics of the instructional material is known as intrinsic cognitive load and the effort to process unnecessarily complicated or badly designed instructional materials is extraneous cognitive load. It is recognised that intrinsic cognitive load cannot be altered but effective instructional designs should decrease extraneous cognitive load and increase germane cognitive load while maintaining total cognitive load within the limits of the working memory (Kirschner 2002). This theory has direct implications for designing instructional materials, particularly those requiring the student to self-study without the help of a tutor to facilitate interpretation of information. Mayer (2003) presented students with different types of self-study materials in a series of 4 experiments. These experiments demonstrated that the most creative responses to problem solving activities were given by students presented with information which included multimedia (words and graphics; animated or still) that was contiguous, did not contain extraneous information and was personalised. Gains in understanding, measured by tests of problem-solving transfer, of 36% to 116% were achieved. Effect sizes ranged from 0.48 to 2.16, with most averaging above 1.00. These findings were evident whether

the students were given this information in a conventional paper based form or on a computer screen. They concluded that the principles of instructional design do not change when the learning environment changes and the cognitive process of selecting, organising and integrating information from both verbal and visual channels is the key to meaningful learning. These findings are based on significant empirical results gathered over several years through robust experiments. This research therefore allows developers of multimedia learning tools to apply these principles of instructional design to promote maximal cognitive gains.

Learning theories relating to clinical practice

While it is useful to consider cognitive learning theories when designing and developing learning experiences for students in higher education, it is also necessary to consider the full picture of skills required to achieve desired competencies and capabilities, particularly in vocational professional courses. The Chartered Society of Physiotherapy (C.S.P.) describes professional competence as:

- A responsibility to ensure the safety and efficacy of practice
- An ability to think critically about practice, learn from this and apply the learning to subsequent professional activity
- A recognition that competence does not exist in a vacuum but is affected by individuals' interaction with others and the context in which they work
- A recognition that competence, and therefore scope of practice develops over time
- An ability to deal with the routine and the non-routine.

(C.S.P 2005)

For most health professionals it is therefore important not only to remember how to treat patients with particular problems but to adapt to the individual needs of each

patient within the specific context in which interventions are taking place. Tutors are faced with ensuring that students have assimilated the required knowledge and understanding and may concentrate on ensuring coverage of required content in their learning activities. Activities encouraging students to think deeply about this new information and construct their own meanings allowing new applications of this knowledge may take second place due to time constraints. It is therefore sometimes tempting for students who are unable to constructively apply their knowledge to assimilate a "recipe book" of solutions to particular clinical problems but this approach lacks flexibility in tailoring of interventions to the needs of the individual. Within health science education it is important for students to reason clinically while appreciating the context of their practice. Clearly the acquisition, understanding and application of knowledge to solve problems is an important part of the learning required to become a competent clinician. However a lack of appreciation of the context in which the problem occurs and lack of ability to critically evaluate practice could lead to professionals being unprepared for clinical situations beyond the routine and failing to continue developing their competence.

Ironside (2005) also recognises this problem and argues that a cognitive pedagogical approach alone is insufficient, where thinking is evidenced by the student's ability to memorise, recall, and apply knowledge to solve particular clinical problems. She suggests that this approach can lead educators to focus on ensuring coverage of "essential content" rather than drawing on the need for an experiential base, which allows the application of this knowledge in various clinical situations, rather than remembering formulaic solutions to problem. Ironside (2005) conducted qualitative investigations which involved interviewing tutors and student nurses about their

experiences of new pedagogical approaches to learning. Following this research she suggests that a narrative pedagogy, which encourages students to explore different clinical situations and analyse the complexity of these situations, may lead to the development of deeper clinical reasoning processes constituting professional competence. Her research raises questions about the emphasis placed on content memorisation in the teaching of student nurses but this research does not provide empirical evidence that adopting narrative pedagogies affects the way in which students learn.

Experiential learning plays an important part in increasing the significance of cognitive learning through addressing the needs and wants of the learner. Rogers (1994) suggests that learning be facilitated through student involvement and personal interest, direct confrontation of practical problems and self-evaluation in an unthreatening environment. This pedagogical approach places the onus of learning firmly on the student, however Bandura (1977) states that:

"Learning would be extremely laborious, not to mention hazardous, if people had to rely solely on the efforts of their own actions to inform them what to do."

His social learning theory suggests that people learn by modelling the behaviour of others and that for the behaviour of the learner to change there must be continuous reciprocal interaction between cognitive, behavioural and environmental influences. He stresses the importance of symbolic rather than overt rehearsal, which codes the behaviour into words, labels or images resulting in better retention. This modelled behaviour is more likely to occur if the model is similar to the observer and has admired status (Bandura 1977). Vygotsky's (1978) social development theory concurs with the importance of social interaction to facilitate learning. He states that for full

cognitive development to occur social interaction is required. Experiential and social learning pedagogies are particularly relevant to physiotherapy and other health science students. These professions necessitate the acquisition of practical skills requiring demonstration from qualified practitioners and practice through self-study and self-assessment from the student in order that they carry out these techniques effectively and appropriately in the care of their patients. If properly supported in their self –study activities students may gain more from practical and workshop sessions using experiential and social learning. Activities such as these, if properly facilitated could allow students to not only embed the necessary knowledge and techniques in their cognitive schema but also facilitate deeper discussion of the related clinical practice and allow students to develop flexible thinking about their application in different contexts of practice.

Bahn (2001) discusses the relevance of Bandura's social learning theory to student nurses and comments that although health science professions have made extensive use of practice based learning it takes more than just placing a student in the practice environment to facilitate the acquisition of practical skills. She suggests that in demonstrating practical skills, verbalisation of behaviour by experienced practitioners can identify aspects of a task not clearly visible. She also suggests that videos may help to ensure that the learner has observed all the elements of required behaviour as they can be re-visited and used as a basis for discussion and self–assessment (Bahn 2001). Lave & Wenger (1991) describe situational learning as a "community of practice" and suggests the presentation of knowledge in an authentic context. Videos could thus allow students to access more authentic materials, such as real patients, in the university setting. Patients would not normally be encountered in the theoretical

university setting and students would have to wait until clinical placement to apply their knowledge and techniques in an authentic clinical setting. Videos, although not providing a "hands on" experience could allow students to visualise the types of clinical problems patients may present with. In the case of physiotherapy and occupational therapy these images are more authentic than static pictures as these professionals are concerned with improving the physical and mental function of patients and videos allow the interpretation of patients' movement and communication.

Kelly (1999) identified the stress experienced by new graduate nurses due to the pressure they feel to "fit in" to the practice environment and the importance of preparing students to make the transition between academic learning and the workplace. It is important therefore to find authentic ways of allowing students to develop their practical skills with opportunities for practice and self-assessment. These self-assessment materials should increase germane cognitive load and minimise extraneous cognitive load. Students, having a sound grasp of basic principles, would thus gain more from practical tutorials and workshops through discussion relating to different applications and contexts. This may in turn lead to an improved sense of self-competence and thus possibly reduce students' anxiety toward practice based learning.

Using learning theories to facilitate clinical competence.

In considering the desired behaviour of competent practitioners it may be that a combination of cognitive, experiential and social approaches to learning is needed to facilitate acquisition of desired skills for competent clinical practice. Diekelmann (2001) notes that these pedagogical approaches are not mutually exclusive and can co-occur. Kaufman (2003) described how andragogy, self efficacy, constructivism and reflective practice theories can be applied and related to medical teaching and learning and suggests seven principles to guide teaching and learning in medical education, allowing these theories to be converted into practice.

1. The learner should be an active contributor to the educational process.
2. Learning should closely relate to understanding and solving real life problems.
3. Learners' current knowledge and experience are critical in new learning situations and need to be taken into account.
4. Learners should be given the opportunity and support to use self-direction in their learning.
5. Learners should be given the opportunities and support for practice accompanied by self-assessment and constructive feedback from teachers and peers.
6. Learners should be given opportunities to reflect on their practice, this involves analysing and assessing their own performance and developing new perceptions and options.
7. Use of role models by medical educators has a major impact on learners. As people often teach the way they were taught, medical educators should model these educational principles with their students and junior doctors. This will help the next generation of teachers and learners to become more effective and should lead to better care for patients.

This last principle reflects the educational role of many health practitioners and the importance of setting good educational examples to our students. Through demonstrations in the practical class setting tutors act as role models for students. Video enhanced self-assessment materials could not only increase students' exposure to tutor demonstrations but also allow them to view the interactions of qualified therapists with patients before their clinical placements. In health science education we should therefore provide students with opportunities for practice and self-assessment which are clinically relevant and build on the learners' prior knowledge and learning needs. Feedback is also essential to allow students to reflect on their performance and continue to develop their knowledge and skills. Video technology may be very useful in helping tutors to achieve this. With this in mind, the next section will examine how opportunities for self study, practice and self assessment may be increased by using technology to enhance access to clinically relevant materials which allow practice related self assessment with feedback and are integrated into the campus based curriculum.

The use of e-learning for self-study.

To encourage students to take increased responsibility for their own learning, construct their own learning experiences and therefore become active learners they should experience learning activities supportive of self-learning. Traditionally these materials have been provided through directing students to book chapters to answer particular questions. Video or sound based materials are generally stand-alone or have been designed with generic subject objectives in mind which may not be obviously clinically relevant or specifically related to prior learning. Computer-based

technologies allow more flexible access to integrated multimedia such as hyperlinked text, video and sound rather than having to rely on the availability of such materials from the library. It therefore seems logical to use them to develop self-study materials to support specific course requirements. Learning theories relating to self-study and studies investigating the use of these technologies will be discussed in this section to allow identification of best practice in this area.

Rowntree (1990) recognises that even in conventional instruction learners spend time learning on their own from existing materials such as books and journals but acknowledges that private study materials are rarely created specially for them with their needs and courses in mind. Thus for student centred learning to occur these activities should be structured to relate study to the required learning outcomes of the course or module and allow students to assess their own performance and abilities thereby encouraging reflection and identification of further learning needs. Schuttenberg (1984) suggests that students should be encouraged to participate in the diagnosis of their own learning needs. This is supported by Cennamo & Dawley (1995) who state that self tests allow students to bypass information they find unimportant or unnecessary and therefore structure their own learning.

Rogers (1994) sees the teacher as the facilitator of learning and stresses the importance of self-pacing and the applicability of learning to the student. Teachers and tutors should therefore be closely involved in the development of specific self–study materials to ensure relevance to prior learning, clinical requirements and module learning outcomes. Teaching staff's reluctance to use emerging technologies to facilitate learning has been identified as a barrier to their uptake whilst lack of

training and low rewards for innovative teaching and learning were identified as potential reasons for this (Albright 1996). Tutor reluctance has resulted in much of the development of these technologies for learning being carried out by educational technologists or staff interested in and confident with computer technology. Staff identifying a potential use for technology in their modules and courses should therefore be encouraged to seek support from information and educational technologists to ensure that computer-based learning materials are applicable to the specific learning situation.

If computer-assisted learning programmes are to be seen as a way forward in providing self-study materials tailored to meet both the needs of the student and the learning outcomes of the course it is not only staff who may require support in their use. Howatson-Jones (2004) comments that nurses offered access to post qualification web-based courses requiring this form of self study may be reluctant to take part in these activities if they have little previous experience of this type of activity. She suggests preparatory courses, which include this type of learning, to alleviate anxiety about web-based learning. However, rather than having to design introductory modules to support post-graduate web based courses, benefits may be gained by exposing undergraduate students to this type of study at a level relevant to their learning needs. This could serve not only to increase their access to self-study and practice but also prepare them for distance learning web-based activities and courses designed to support their continuing education once qualified. It must be remembered that these students may also lack exposure to this type of learning and should similarly receive support and proper introduction to these new methods of self-study.

Sorge et al (1991) suggest that if learners are high in computer knowledge, low in anxiety and highly motivated they should need less human intervention.

Honey (2000 p.1), however, has doubts about the effectiveness of e- learning once the initial novelty has worn off. He says that motivation may dwindle as formal learning is:

"Difficult to sustain when it is discretionary and tackled as a solo pursuit"

He also warns against the assumption that people know how to learn and says that:

"Churning things out on a hit and miss basis, but on a screen instead of paper, and maintaining that it caters for peoples needs, simply will not do."

He suggests that e-learning can make use of its flexibility and reach if it focuses on the learning process and harnesses its ability to adapt to different learning styles. E-learning's' flexibility allows tutors to tailor specific content delivery in a variety of different ways such as written words, pictures, animation, sound and numbers to allow students with different preferred learning styles to choose how they interpret this content. It also allows easy access to the information, and if web-based, remote access is facilitated. Self-tests incorporating timely feedback can be designed relating to specific learning outcomes and delivered as appropriate. Lawton (1996) suggests that if information given in self-learning is related to the adults existing knowledge then there is more chance of learning occurring. It has been theorised that exposure to multiple representations of required knowledge can facilitate the transfer of this knowledge beyond the initial learning situation (Spiro et al. 1992). It is also suggested that these representations are case based and that knowledge sources are highly interconnected (Spiro et al. 1992). It would therefore be important to ensure that self-study materials are very closely linked to the learning outcomes and required knowledge content of the modules they are designed to support, while providing an

alternative representation of that information. In this way providing adult learners with the opportunity to sit down quietly and consolidate knowledge with structured, relevant, self-study materials that allow self-assessment and give feedback could prove a very, motivating and rewarding experience.

Experiential Learning and feedback

Kolb (1984) postulates that for experiential learning to occur the situation must allow active experimentation, reflective observation, concrete experience and abstract conceptualisation. Percival et al (1993) suggest that it is difficult to know whether these components of experiential learning should occur sequentially and if so where to start. A more flexible approach is suggested by Race (1994) illustrated below;

Ripples on a Pond

From; Using feedback to help students learn (Higher Education Academy Publication)

The ripples are interconnected and allow inward connection as well as outward. This model allows feedback to be taking place while the learner is doing and digesting and therefore to continue doing while receiving feedback and digesting this. Wanting and needing refers to the motivating factors stimulating students to learn, for some students this may be getting a good mark in the assessment, for others the preparedness for clinical placement may be more motivating. Feedback has an important role to play in motivating students through positive reinforcement and allowing the identification of further learning needs. Doing refers to the activities facilitating the assimilation and accommodation of knowledge, which may occur through concrete experience, observation and active experimentation. Digesting allows students to reflect on these experiences and their feedback and thus make sense of the information through consolidation and application of their knowledge to other situations. The phases of doing and digesting in Race's (1994) model could be said to relate to Kolb's (1984) phases of experiential learning where doing involves active experimentation and concrete experience and digesting entails reflective observation and abstract conceptualisation. The notion that computer based learning contributes well to this model of learning is supported by Race (1994) as it can motivate through stimulating media such as video, learning by doing occurs through interaction with the material and this is enhanced when feedback is given. Digesting is facilitated as the student can repeat their use of the materials as often as they wish and in the way that they choose. Some disadvantages of this type of feedback are also suggested by Race (1994):

- The tutor cannot tell to what extent students are benefiting from this feedback.
- Students who don't understand may not be able to get more depth of feedback from the tutor.

- Students may not retain the feedback as they move from one screen to another.

Awareness of these potential problems allows developers of computer-based self-study materials to take steps to alleviate them and investigate the extent to which they have been successful. Wolfson (1996) states that adult students using computer assisted learning programmes prefer to have someone nearby to help them if they need it. It is therefore important when introducing learners to computer assisted learning that they are not de-motivated by lack of confidence as this may affect future interactions with this form of learning. Supporting learners as they take their first steps with this type of learning medium is therefore crucial and it may be that in the early stages the presence of a tutor will help to facilitate this confidence. If students who don't understand their immediate computer-based feedback need further clarification from a tutor an on-line discussion group may allow immediate reporting of the problem and prompt a reply from the tutor, other students with similar misunderstandings can then share this information. Campus based students also have the opportunity to raise misunderstandings in face to face sessions, providing a basis for further discussion of the topic. In this case it would be important for the self-study materials to be fully integrated into the module and for the module teaching staff to have an awareness of the self-study materials, possibly through being involved in their development. Integration and discussions of this nature could enable tutors to examine how students are retaining the feedback they receive and whether they are benefiting from it. Further, investigation of students interactions with this type of feedback when developing computer based self study materials will allow more formal evaluation of whether this is the case and how best to alleviate these problems.

Deep, surface and strategic approaches to learning.

Ellington & Earl (1996) emphasise the importance of approaches that encourage deep learning rather than surface learning. These approaches were first described by Marton & Saljo (1976) who conducted research into how students approached reading an academic article. They wanted to discover the following

1. What does it *mean* that some people are better at learning than others?
2. *Why* are some people better at learning than others?

Learning was studied under comparatively natural conditions and the aim was to describe it through the eyes of the learner. Students were informed that after reading a text they were going to discuss their understanding of it with the experimenter. Students were interviewed about their understanding of the text and were asked to give as full an account of the text as possible. The interview continued with questions about their experience of the situation and they were specifically asked how they had gone about learning the text. The interviews were tape-recorded and subsequently transcribed verbatim. On scrutinising the transcripts various distinctively different ways of understanding the text were identified. These could be categorised by their description and by the relationships between them, thus a hierarchy of these descriptions was established called the outcome space. The outcome space provided a measure of how well learners succeed with their learning task. Differences were also found in how students experienced the learning task. Some of the students tried to understand what it was about while others tried to remember the content. The former way of relating to the learning situation was called the deep approach and the latter the surface approach. It was found that the deep approach was closely associated with "higher" categories of outcome (i.e. better understanding of the text) while the surface approach was associated with "lower" categories of outcome (i.e. more shallow

understanding of the text). There was thus a strong relationship between the way in which the students understood the content of learning (the text) on the one hand and the way in which they experienced the learning situation (and their own act of learning), on the other. Marton & Saljo (1976) came to these conclusions after a series of qualitative experiments. Although their approach is qualitative they applied rigorous procedures of interpretation to their detailed data.

This work is now considered the beginning of the phenomenographical approach to educational research and seminal to this field. This theory relates to how students may approach a learning task rather than suggesting a fixed stereotype such as learning style, which is inherent to the character of the student and may not be altered. The theory suggests that if teachers can encourage students to take a deeper approach to learning, students will develop a more thorough understanding of the material. The learning activities we set our students should therefore promote a deeper approach to study and it has been suggested by various authors that assessment, whether formative or summative in nature could affect the approach taken by students.

This idea that students approach learning in different ways depending on the task is supported by Laurillard (1997). She suggests that students change their approach to different tasks according to the different demands they perceive to be placed on them. Entwistle et al (2000) in continuing the work of Marton & Saljo (1976) also identified that assessment tasks have a profound effect on how students perceive the required demand on their learning and subsequent study strategies. Entwistle et al (2000) state that this calls for the recognition of a further approach which is also associated with deep learning called a strategic approach. They suggest designing activities that

promote a deep strategic approach to study rather than a surface apathetic approach. This may be achieved by designing assessments which encourage students to think for themselves by demonstrating understanding, applying knowledge and solving problems, rather than just memorising and reproducing information (Entwistle et al 2000). Students who adopt a deep approach have been found to be more enthusiastic towards self-study and also to perform better in self-assessment tests (Jones & Kember 1994). The content and format of these assessments should also be closely aligned to the learning outcomes of the course and thus it is important to ensure that these outcomes require some demonstration and application of personal understanding rather than reproduction of facts (Biggs 1999). Entwistle et al (2000) highlight the influence on these outcomes of target understanding which is that determined by the appropriateness of the outcomes for a particular course and age group e.g. as determined by a professional body such as the Chartered Society of Physiotherapy. Entwistle et al (2000) suggest, however, that teachers also interpret the syllabus and this in turn influences the development of component learning outcomes, learning activities and assessments. The challenge therefore to the teacher is to design these while keeping the goal of deep strategic learning in mind.

Ward (1998) designed computer based case scenarios relating to business information systems and investigated the design features influencing active and deep learning. He used Entwistle's learning inventory to discover the learning approaches of 40 students using the learning materials. Accessing the logs of the computer system containing individual student identification numbers monitored students' use. Ward (1998) found that those who used the self-assessment components of the materials were almost exclusively the deep learners: 85 times accessed compared to 5 times for

surface learners. Deep learners also performed better in the assessed coursework and examination, achieving an average of 63% compared to surface learners 36%. Although the number of students studied is relatively small and did not allow for statistical testing the results provide a convincing argument for encouraging students to use computer-based self-assessment. Although use of these self-tests may have contributed to enhance the learning of these students, it may just be that deep learners tend to do better in assessments generally. It is not known whether surface learners who are encouraged to use computer-based self-tests adopt a deeper approach as a result.

It is important in any learning situation to examine and understand the learning preferences and styles of different students so that materials designed to facilitate and improve learning take account of these variations and offer flexibility and adaptability within study materials as suggested by Honey (2000). The next section will therefore examine students learning styles in relation to health science subjects and computer assisted self-learning.

Cognitive learning styles, preferences/attitudes of students and their relationship to computer-based learning/e-learning.

Cognitive styles refer to the preferred way in which an individual processes information. They describe how a person thinks, remembers information and problem solves. Cognitive style denotes a tendency to behave in a certain way and can influence attitudes, values and social interaction. It will thus have an effect on the type

of learning experience an individual prefers and feels is of most benefit to their learning; this type of cognitive style is referred to as learning style.

Pask (1975) described two different learning strategies adopted by learners, serialists who progress through learning material in a sequential fashion by breaking it down into sections and holists who tend to need an overview of the concept and learn in a hierarchical "top down" manner. Kolb (1984) describes four types of learning styles: divergers, assimilators, convergers and accommodaters. These styles relate to his stages of experiential learning, an accommodater, for example, prefers concrete experiences and active experimentation (Kolb 1984). Honey & Mumford (1992) based their research on learning styles on that of Kolb and consequently the two theories have close links. The four learning styles identified by Honey and Mumford (1992) are: activists who learn by doing, reflectors who learn by thinking analytically about the material, theorists who pull together facts objectively to form theories and pragmatists who like to try out new ideas and problem solve. Learners will possess some traits of each of these styles but will have a tendency to lean towards some in particular. The learning styles of Kolb (1984) and Honey & Mumford (1992) are related as follows:

- Activist = accomodator
- Reflector = diverger
- Theorist = assimilator
- Pragmatist = converger

These styles are also closely aligned with the stages of experiential learning proposed by Kolb (1984) active experimentation, reflective observation, concrete experience and abstract conceptualisation. If a learner tends to seek out only the type of learning

activities suited to his learning style there is a danger that he could not develop a deep cognitive understanding from the learning experience. It is therefore advisable for learners to be exposed to learning materials encouraging the adoption of a variety of learning styles. This would allow learners not only to engage with the activities which suit them but enable them to interact with those less familiar and develop more balance within their learning styles.

Learning styles in relation to course group.

There are many instruments that have been devised to investigate the learning styles of students. The learning style inventory most reported, as being used with health science students is that of Kolb (1984). Student nurses learning styles were assessed using this tool at the commencement of their studies and relationships between their learning style age, gender, educational attainment and previous work experience investigated. It was found that 54% of the students had predominately accomodator/diverger scores which relate to concrete learning style and 46% had predominately assimilator/converger scores relating to reflective learning style (Cavanagh & et al 1995). The study did not find any significant relationships between learning style and gender, age or educational level. Kolb (1984) has previously theorised that concrete learners tend to choose people-orientated professions and these results would seem to support this. Kolb's Learning styles inventory is known to have less reliability over time as the results for a student at one test may differ with subsequent testing (Sims et al. 1986). Cavanagh et al (1995) suggest that self knowledge and experience of the respondents may influence their preferred learning style and that this is likely to change over time as, in the light of their clinical experiences, they question the delivery and content of their formal learning. It is

therefore possible that the delivery of learning may influence the development of students learning styles. Exposure to a variety of learning experiences would be required to allow development of the less dominant styles.

Vittetoe (1983) used the Rezler-French learning preference style index with 9 physiotherapy and 34 medical technology students graduating in 1978 and compared this with the indices of 32 physiotherapy and 68 medical technology undergraduate students in 1982. She found that the first preference of physiotherapy and medical technology students was for concrete active learning experiences. In the Rezler-French instrument these constitute tangible, specific skill-focussed practical tasks. The second preference of both groups of students was for teacher-structured learning constituting well-organised teacher-directed activities with clear expectations, goals and assessment tasks. She found that there were no significant differences between groups studied in 1978 and 1982 although the means compared were those of the composite group (Vittetoe 1983). There were some important differences between groups of physiotherapy students with the 1978 group preferring student-structured learning significantly to the 1982 group ($p=0.04$). The 1982 medical technology students preferred interpersonal learning (working with others $p=0.02$) more than the 1978 group. The medical technology group was much larger than the physiotherapy group and this could have biased the composite group results. Although the results do seem to suggest that both groups of students, regardless of year, tended to prefer concrete learning experiences some students scored very low on the concrete scale and much higher on the abstract scale. Vittetoe (1983) suggests these students should also be supported in their learning. These results also suggest that there may be differences between the learning preferences of students on the same course, which

may change, in different years of students. While it may be impossible to cater specifically for these suspected differences due to time and financial constraints, it could be detrimental for teachers to assume that a particular course group has a preferred learning style.

Wessel et al (1999) also used the Kolb Learning Style Inventory to determine the learning styles and perceived problem solving ability of Physiotherapy students. They found that the majority of students had the preferred learning styles of assimilator or converger. They tested students in years two to four of the degree programme and found no significant differences in leaning styles across the years. They concluded that Physiotherapy students prefer a learning style in which abstract conceptualisation is combined with reflective observation or active experimentation. These findings differ to those of Vittetoe (1983) who found two different groups of physiotherapy students to prefer concrete, teacher centred learning experiences. Wessel and colleagues (1999) findings also conflict with those of Cavanagh et al (1995) in two respects. Wessel et al (1999) suggest that the lack of change in learning style over the years may be because the educational programme does not influence it but that a student with a particular style preference chooses the course and performs better in the interview. The preferred learning styles of physiotherapy students, described by Wessel et al (1999), seem to differ from those of Vittetoe's (1983) study and those of nursing students in Cavanagh et al's (1995) study. This challenges the assumption that concrete learners choose people orientated professions and also gives less credibility to the theory relating choice of profession to learning style. It may still be that learning style is influenced by educational experience but that it was not evident in these particular groups of students.

Linares (1999) found self-directed learning readiness appears to affect learning style and convergers, which was the predominant learning style among this sample of health care professions, were more self-directed than the other styles. Wessel et al (1999) also found a preference for the converger style among second and fourth year physiotherapy students. The inclusion of fourth year students in this study may be responsible for the differences in learning style between students in Wessel et al's (1999) study and those of Cavanagh et al (1995) and Vittetoe (1983). Fourth year students, having more experience in higher education, may be more used to self-directed learning and therefore have developed a preference for the converger learning style.

Further research is required in this field to clarify how learning styles relate to professional choice and whether teaching methods can influence them. Therefore with no clear picture of a typical learning style favoured by health science students, tutors should be aware that although most students may show an overall preference for a particular learning style there will still be those among the group who do not prefer the majority style. Bonham (1988) reviewed and critically evaluated several learning style instruments and has concerns about their validity, reliability and thus the adoption of their use. The instruments evaluated were the Embedded Figures Test, Hill's Cognitive Style Inventory, Kolb's Learning Style Inventory and the Canfield Learning Styles Inventory. It is recommended that in order to minimise their weaknesses the instrument is chosen with the specific situation for its use in mind. Students should also be encouraged to evaluate and critically interpret their scores and to expand their style ranges. Caution should be used in making decisions about

teaching methods in light of the results and trying to match teaching methods to specific styles (Bonham 1988). When designing learning materials there is a need to ensure that they are accessible and useful to the whole group and if they can influence the development of less favoured learning styles that we encourage their expansion through a broad range of learning activities including encouraging self-directed learning.

Styles and preferences of students in relation to computer-based learning

The relationship between matching and mismatching instructional presentation style (depth first or breadth first) and assessing students cognitive style (field dependant or independent) was investigated by Ford & Chen (2001) using Riding's Cognitive Styles analysis. Parallels were drawn between Pask's serialist and holist learning styles in that a holist would relate more to a breadth first instructional style and a serialist to a depth first instructional style. Seventy-three students were set the task of creating a web page and given either a breadth first or depth first instructional web based tutorial on Hypertext Mark-up Language (HTML). Even numbers of students with field dependent, independent and intermediate cognitive styles were allocated to each type of instruction. The students took pre and post-tests to ascertain their knowledge of HTML and were set a task, which was to build a web page. The task and knowledge gain scores were calculated and the effect of matching or mismatching determined. Matching was found to promote significantly higher scores for knowledge gain but there was no significant difference in task gain between matching and mismatching. When gender differences in task gain were examined, males in matched conditions were found to improve their task gain scores significantly more than females. A total of only 73 post graduate students were tested giving quite small

numbers of students in each group which affects the significance of the results. It is not known what subjects these students had studied previously or if they were all from the same undergraduate backgrounds, though prior knowledge of HTML was accounted for by the pre-test scores. These results cannot therefore be generalised to a larger population. The authors recognise that the investigation was also carried out in experimental conditions and that the results may not translate into the real learning situation. However Ford & Chen (2001) recognise the capabilities of computer based instructional materials to deliver flexible learning materials while at the same time collecting information about learning activities and outcomes.

Phillips (2005) notes the advantage of active on-line environments in allowing the incorporation of sound and pictures to facilitate learners with auditory and visual learning styles. Kinaesthetic activities and practical skills may also be facilitated directly through practical activities such as typing and navigating with the mouse. Indirect facilitation of kinaesthetic skills could occur by allowing students access to images and sound of practical skills in a computer based environment allowing them to copy and practice these as and when they choose. French et al (1994) emphasise the importance of skill practice for physiotherapy students and have suggested that the provision of videos may allow students access to review of practical techniques when the tutor is unavailable. Students are actively encouraged to practice "hands-on" techniques, using each other as models outwith practical classes but are advised of any safety issues and contraindications before they do so. An easily accessible summary of the technique allowing review by the student before commencing unsupervised practice could help to promote correctness in application of the

technique and also allow review of safe practice. This would be particularly beneficial if formal teaching had been delivered some time previously.

Van der Velden (1999) makes recommendations for designing computer based learning materials taking visual and auditory learning styles into account. She says that the most basic and obvious learning preference is for visual and auditory intake of knowledge. Thus a module providing both visual and audio representations of content caters for both and is easily achievable using multimedia technologies. Van der Velden (1999) suggests supporting preparation for exams and study advice by incorporating these into computer assisted learning packages. Allowing students the opportunity to fail and retry will help students to develop knowledge they can use creatively. Using computer based learning in this way, to allow revision and review, supports theories of experiential learning (Kolb 1984; Race 1994) through allowing students to learn by doing (engaging with interactive multimedia) and receive feedback about areas requiring further study. Feedback should not just consist of right or wrong but give the student an explanation about why the mark has been given. This will not only provide information about where the student is weak but also provide possible solutions to address this allowing digestion of correct knowledge and greater understanding. Positive feedback could also benefit students motivationally if they see their self-assessment scores improve with repeated attempts. In order to avoid the separation of knowledge systems and avoid students being unable to relate what they have learned to other parts of the course Van der Velden (1999) suggests relating computer-based learning packages to something they already know i.e. the rest of the course content. It is therefore important to develop packages with module learning outcomes in mind so that they can be fully integrated with module and course content.

Integration could be further improved by basing all the related materials within a Virtual Learning Environment (VLE) and linking them to module materials but it should be recognised that this adds a further dimension to the computer-based learning experience which is also affected by students' individual differences.

Richardson (2001) examined the relationship between the individual differences of students and how these interact with their perceptions of working in a VLE. She found that students generally felt VLEs provide a flexible learning environment but availability of resources may restrict this. However the students felt isolated and not part of a learning community as group and collaborative work decreased since the introduction of this medium. Female students had more negative perceptions about the VLE than males, which Richardson (2001) concludes, could have been due to the lack of collaborative and interactive opportunities but also their reported lack of IT competence. It would therefore be important if using this type of learning environment to ensure basic introduction and training for all students and opportunities for group collaboration and interaction, particularly in health related courses where the majority of students tend to be female. Richardson (2001) also found that students with positive perceptions of VLEs had developed time management skills, were internally motivated, enjoy independent learning activities and were analytic rather than holist.

Hernandez-Jorge et al (2003) investigated the differences in students' use of information and communication technologies and their perceived advantages and disadvantages of e learning in relation to gender and age. A previously piloted questionnaire was given to 730 students, 73% of whom were women, from a variety

of courses but the largest proportions being from law, social and human sciences. Subjects were in the first (55%) and second (40%) years of their study.

Findings revealed that male students used computers and the Internet significantly more than women did but women were more likely to use them for work and study whereas men used them more for leisure and playing games. Year group did not seem to influence use other than the fact that second years have been more familiar with these technologies for a longer time, possibly due to earlier exposure than first years. However the study did not look at students with vast differences in age such as those at school before the widespread use of computers, mature students and those who have been exposed to computer use for most of their lives. A study of this nature would possibly show more significant differences in attitudes and use relating to age. Where e-learning was concerned they found no significant differences in attitudes in relation to age and gender but though women tended to identify more advantages relating to autonomy and learning they also voiced more concerns with technical difficulties and lack of visible communication with the teacher and classmates. These findings support those of Richardson (2001). Advantages of e-learning identified by first year students were provision of information related to the course, improved quality of learning and increased student motivation. Second years identified that they may not have to attend classes so often if they had access to e learning (Hernandez-Jorge et al 2003). These authors suggest that further research should consider the relationship between familiarity with technology and its perceived advantages.

Van Dover & Boblin (1991) studied student nurses' preferences for learning in relation to computer experience. They found that there was much variation between

the student's actual experience and preferred experience. The student nurses showed the strongest preference for learning applications for clinical practice rather than those for education and administration though they were very positive about learning all of the applications presented to them. It was interesting to note that the most common form of computer learning they used was word processing, only 34% used computer literature searches, 15% for outlining essays, 4% for study notes, 4% for nursing care planning and only just over 1% for clinical decision making. It is clear that lecturers and faculty staff need to address the gap between the students' expressed needs and their opportunities for learning with and about computer based applications.

Vuorela & Nummenmaa (2004) investigated how 42 undergraduate medical and sociology students interacted with a web-based learning environment depending on their attitudes, beliefs and perceived self-efficacy, they also examined the students anxiety, approaches to learning and interpretations of the environment and learning situation. They tried to discover whether these beliefs and attitudes would predict the students' activity with the web-based materials; however they found that these beliefs and attitudes were not predictive of the students' activity with the learning. Activity, in this study was measured quantitatively rather than qualitatively and therefore it is unknown whether these particular beliefs and attitudes would affect the type and quality of students' activity with web-based learning. They found more negative attitudes and beliefs did not limit the use of the web-based learning though participants developed more negative attitudes to the environment following the course which they suggest could make them reluctant to participate in such learning activities in future (Vuorela & Nummenmaa 2004). Medical students developed more negative attitudes than sociology students did following the course. It is suggested

that this could be due to differences in tutor experience with the web-based environments; the sociology tutor had more experience. The course for each set of students was different though based in the same environment therefore course content may also have had an effect on students' post-experience attitudes, however students attitudes towards and satisfaction with the course content was not evaluated. Students who adopted a deep approach to studying had more positive post-experience attitudes towards the environment supporting the findings of Jones & Kember (1994). Students whose anxiety levels were high had lower expectations of the learning environment though interestingly anxiety was not found to effect students' post-experience attitudes (Vuorela & Nummenmaa 2004). The authors point out that their sample was small (42) and only consisted of medical and sociology students therefore the results can only be interpreted in relation to this specific learning situation.

In summary the relationship between students' individual differences and preferred learning styles and their attitudes to and perceptions of e-learning / computer based learning (CBL) remains unclear. It seems that CBL may cater for and encourage deep approaches to learning and the development of a wide range of learning styles. Packages providing a wide range of learning activities and media should therefore be developed to support and encourage this diversity. It may be the case that male students and those with increased experience of computer technology have more positive attitudes towards e learning. When integrating this type of learning into courses we should therefore ensure that students do not feel disadvantaged and possibly demotivated to use these tools by ensuring sound basic training in computer skills and interactive support for students while using the materials. This may be particularly important in courses such as Nursing, Physiotherapy and Occupational

Therapy where the majority of students are female and there may be a significant number of mature students. These students seem to prefer active learning experiences integrated with the rest of the course material and clinical skills and we should ensure that computer based materials are developed with this in mind. Further investigation is required into the effects of age, gender and attitudes towards computers and students' satisfaction with e-learning to discover whether results form previous research are reproduced with different student groups in other learning situations.

The use and evaluation of e-learning in health related courses

This section will review studies in the use and evaluation of computer based learning materials within health science and related courses. Since the turn of the millennium higher education institutions have increased their capacity to deliver computer-based learning (The Welsh Office 1999). This has been largely driven by the increasing demand for open and distance courses, which make extensive use of these methods of teaching and learning. Consequently much of the early research into computer-based learning has been conducted in the context of open and distance learning. While we can learn much from this work this project aims to use computer-based learning to support campus-based health science courses. Studies contributing to this knowledge base will therefore be reviewed.

A comprehensive review of qualitative and quantitative studies evaluating CBL in nursing education was carried out by Lewis et al (2001). They searched all the major databases relating to nursing education and searched under all the synonyms of CBL at that time, though they did not use the term e-learning which is the more recently

evolved descriptive term encompassing all forms of computer-based and assisted learning. The review summarised the major findings and design flaws of all the studies included. They were unable to derive substantive evidence as to the overall effectiveness of CBL in nursing education for the following reasons. There is so much variability between the study designs which vary from anecdotal reports to randomised controlled studies and they tend to be so highly context specific that their results cannot be extrapolated to a general situation. It is extremely difficult to control for non-CBL variables within groups and to prevent contamination between the group allocated to CBL and the group using the conventional materials. Comparison of results between different classes and years will also contain bias from uncontrolled variables. Another confounding factor they suggest is the "changing goalpost situation" as the technology develops so rapidly that in a year, expectations and thus evaluation criteria of the computer based material will have changed (Lewis et al. 2001). They suggest therefore that the ultimate judgement of the efficacy of the package should be based on how well it achieves its intended objectives. They recognise the need for further studies evaluating CBL. Lewis et al (2001) conclude that CBL has great potential in nursing education in terms of effectiveness and efficiency in meeting educational requirements, catering for a wide range of learning styles, improving skills and confidence in the use of CBL and nurturing the desire to use these resources post qualification. These conclusions could apply to the use of CBL in all health related courses. Educational requirements could indeed be more efficiently met through flexible, timely access to learning materials and provision of clinically relevant information and allowing self-assessment of related skills. A wide range of learning styles may be catered for through the use of text, graphics, video and sound. Students using this type of learning in their undergraduate courses may

develop more positive attitudes towards and confidence in the use of these technologies for learning; thus motivating them to seek and demand these flexible learning opportunities post-qualification. Lewis et al (2001) reviewed studies from as far back as 1966 but since their review was published in 2001 there have been significant advances in technology. The changing nature of CBL and e-learning packages requires development of innovative and multiple strategies of evaluation to establish whether they meet their learning requirements.

Lyte and Kerr (1996) developed and evaluated an interactive multimedia package to support the learning of community care for pre-registration nursing students before their clinical placement in this area. They carried out a feasibility study and decided to release the material on CD-ROM. Package development involved collaboration between a private sector multimedia development agency and the teaching staff at the college. This allowed teaching staff to use their time in knowledge engineering and subject matter development rather than the technological development, which can be very time consuming. The package incorporated text, images, animated graphics, audio and video and it was hoped that by combining the theoretical and practical principles in a single learning episode, package implementation would save time for the clinical staff in orientating the students to the specific requirements of this type of placement. Lyte and Kerr (1996) evaluated the package with 250 students through the use of a questionnaire. They concluded that students preferred this way of learning to traditional methods and found it more effective in facilitating their learning to prepare for their involvement in caring for patients. They also suggest that package use resulted in an annual cost saving of around £90,000 due to reduction in resource demand for routine information from teachers and clinicians. Full details of the

evaluation, however, are not presented in the paper. The authors anticipated that future CBL packages should be Internet based rather than on CD-ROM allowing increased and more flexible access to the materials. This would also allow material content to be regularly and more easily updated and changes to be made in the light of feedback from students and evaluations.

Bacro et al (1997) investigated the use of an Internet based study package on the anatomy of the knee joint with health professional students enrolled in the anatomy class. The web site consisted of text and graphics with hyperlinks to navigate through the site. The students were given the web address as well as the conventional dissections. The authors do not give any information about the other computer software that they were given. Their survey of the students' use of the resources revealed that only 18% of them accessed the web site. It was discovered through further questioning that they were unfamiliar with accessing and navigating the Internet. The students were then instructed in these skills and a further survey showed that all the students were familiar with the Internet (Bacro et al 1997). It is not clearly reported whether this instruction contributed to greater student use of the knee anatomy site. This study also lacks full details of the evaluative method and results and did not address whether learning or perceived learning had improved as a result of its use. The importance of ensuring that students have the basic computer skills required for using CBL materials before they are implemented are highlighted by the study.

Increasing student numbers and a need for more flexible learning methods prompted Bull et al (1998) to develop and evaluate a distance learning package for student

midwives on the foetal skull. Although this study evaluates a distance learning package it was thought key to include it in this section as the software used to create the package was an earlier version of the software considered for creating self-assessment questions for this project. The package consisted of a printed workbook containing four topics, each with activities to aid comprehension of the topic and "personal notes" pages for the student. This paper-based component was supplemented by computerised self-assessment questions covering the four topics. These were distributed to the students on five floppy disks. The self-assessment questions were developed using the application Question Mark Designer. Question types available included multiple-choice, multiple response, numeric, text match and graphical hotspot. Students had two opportunities to answer each question and were scored and given appropriate feedback. They could also find out the correct answer. The evaluation took the form of a pilot with 51 midwifery students who had all taken the traditional module previously, were at different stages in their study and varied in age and level of IT skills. The way in which the students were told to use the materials is not reported in the study. A questionnaire was distributed which asked questions about visual impression, ease of use, effectiveness, content, installation, and the printed booklet. The response rate was 100%. The responses to the questionnaire were scored on a 4-point scale and supplemented with informal written and verbal comments. Overall the results were positive towards the package. Negative comments were mostly related to difficulties with installation and shallowness of the material (Bull et al 1998). It is not clear whether the responses were given in a scored manner or whether they were open responses which were scored retrospectively by the investigator; if the latter were the case then this could introduce bias to the results. It is difficult to interpret some of the results without a copy of the questionnaire. It

appears that some of the questions could relate to the package as a whole rather than just the computer based section e.g. content, effectiveness and structure. The authors however have related the results of these sections to the computer-based component but it is not clear whether the respondents were instructed to make this distinction. The more open responses gave clearer feedback with students expressing that they found this form of assessment appropriate for an examination and would consider further computer based study particularly if installation problems were resolved (Bull et al 1998). The authors suggested that the comments regarding shallowness of the material could have been due to limitations of the software; recent advances in this application should allow for more creativity in the structuring of questions. The authors suggested that the package could be delivered via a CD-ROM, which would improve access and installation.

These three studies: Lyte & Kerr (1996), Bacro et al (1997) and Bull et al (1998) used questionnaires to evaluate student attitudes towards CBL. Overall students' attitudes towards these learning resources seem to be positive. More recently studies have attempted to compare CBL to traditional teaching methods and to discover whether learning has taken place.

Studies comparing CBL to conventional teaching and evaluating learning.

Dewhurst & Williams (1998) investigated whether CBL is an acceptable alternative to lectures for the study of the cardiovascular system. A pilot study was first undertaken with 33 first year BSc Dietetics students who were divided into two groups. One group received a lecture on the heart and CBL on the circulation and the other the reverse. Each group completed pre and post-test attitude questions and knowledge

quizzes. The groups were checked for equivalence and distributions were found to be equal. Results of the pilot showed no difference between pre and post-tests in attitudes towards CBL but that attitudes overall were positive. There was also no significant differences in knowledge gain between groups for traditional or CBL methods. Due to problems with attendance and clashes with other study, it was decided to conduct the second extended trial over a shorter time span. The post-test was administered at least one week after the last teaching session rather than immediately after. The second extended study was conducted on a cohort of 39 BSc Physiotherapy students using the same division of teaching methods and the same questionnaires and quizzes. The results for this cohort showed a significant difference in pre test attitudes between the groups with group B having more negative general attitudes towards CBL. There was no significant difference between the groups attitudes post-test as the more positive pre-test attitude of group A decreased post-test. However both groups had a positive attitude towards the role of CBL in study management. Although there was no significant difference between the groups in terms of post-test knowledge acquisition group B did have a slightly better knowledge of the circulation following its instruction by CBL even though their attitudes towards this method were more negative. Dewhurst & Williams (1998) concluded that this CBL package could be as effective as lectures for delivering this content to these particular students but they acknowledge that their results may not be applicable to other learning situations as both lectures and CBL programmes vary in quality and style. The students they tested perceived advantages of CBL as giving more scope in terms of when and where they study, they also suggested it was a "good backup for lectures" and "useful for revision". The authors conclude that further CBL developments should focus on the power of the computer to present problems, which require application of knowledge,

give students immediate and relevant guidance and feedback to support rather than replace conventional delivery methods.

While this study makes a valuable attempt to establish whether CBL is effective in promoting learning it highlights some of the practical difficulties of conducting this type of study. The results are only applicable to this population for this particular learning experience and cannot be generalised to other CBL materials and situations. Even though steps were taken to divide the groups the investigators would not have been able to control for extra curricular discussions between the students in the two groups although by decreasing the time over which the learning activities were carried out they could have decreased this slightly. The second post test was however carried out at least a week after the learning had finished though a reason was not given for this. This period could have served as an opportunity for the groups to swap and compare information. It was stated that students were instructed not to carry out any extra study for the tests but there will always be those students who want to achieve high marks in all their tests and therefore would possibly have carried out their own extra study. It is therefore difficult to conclude whether the knowledge gain was solely due to CBL. Percival et al (1993) describe the problems of scientific evaluation of learning materials. They suggest that if students do not perform as well as expected one should recognise that this may not solely be the fault of the students or the teaching materials but other factors such as: operational problems or mismatching of the materials with the course objectives. In conclusion they recommend the use of a wide range of different kinds of evidence in the evaluation of learning materials. Dewhurst & Williams (1998) expanded this by not only comparing pre and post-test scores but also taking student attitudes into consideration.

In a follow up study Dewhurst et al (2000) replaced the six lectures on cardiovascular physiology with self-study CBL packages. In this case the students, a new group of first year BSc Hons Physiotherapy students, had no tutor support while using the packages and had to organise their own time to study with them. A questionnaire was used before and after the learning to discover students' attitudes towards the learning experience and the examination at the end of the module contained some questions on the material only covered by the CBL materials. Findings indicated that students' attitudes became more positive towards CBL after using the packages. There were some problems with access to computers but generally students felt that CBL was a flexible and effective means of study. The students were offered extra lectures and tutorials to prepare for the exam if they felt the CBL alone was not sufficient but none of them took up this offer. In the section of the exam where the students could choose to answer either a question on the traditionally taught respiratory physiology or cardiovascular physiology, delivered via CBL, 71% chose the cardiovascular question. There was no significant difference in the mean scores for either question (Dewhurst et al 2000).

This study continues to support the acceptability and effectiveness of CBL for the self-study of cardiovascular physiology in this physiotherapy course but Dewhurst et al (2000) recognise that for subjects which require more complex interpretation of the content students may need more access to tutor support. It is also suggested that access to the material would be improved with the advent of fast access to wide area networks, which is now becoming the norm in most universities. The study also attempted to look at how students used the package and found they became more

accepting of working with it on their own, however the authors did not examine the relationship between how it was used and the learning experience. Though it remains difficult to say whether the learning levels achieved in this subject were directly attributable to CBL it is reassuring that such a large percentage of the students felt confident enough to answer the exam question on the subject taught entirely in this way. The change by the students to a more favourable attitude towards CBL for study could promote an increased confidence in their IT skills and less resistance to the use of this medium in the future.

Kohlmeier et al (2000) developed CBL self study materials for teaching medical students about cancer nutrition. Lessons on biochemistry, epidemiology and practice were combined with the video presentation of clinical information and self test questions with answers. Information about how the CBL module was delivered is not given. 163 first year medical students were tested using 20 multiple choice questions chosen from 60, which were also given to the students at the start of the module to act as a study guide. Students' attitudes were collected using a questionnaire with a 5 point Likert scale. Students completed examination style tests before and after the module. Two weeks later they sat a midterm exam which contained two questions on the subject and 40 randomly selected students also took a retention test three months later consisting of the same 20 original questions with their order shuffled. Time spent using the materials was recorded on disks. The percentage of correct answers to the knowledge tests increased significantly after using the CBL materials and the retention tests showed most had retained the information. A significant number of students ($p=0.01$) rated their own skills in the subject as improved as a result of the CBL materials and felt more able to advise patients as a result. Although attitudes

were mostly negative towards this method of study before the module most students were more positive after using the CBL. The authors found no relationship between negative attitude to the materials and the knowledge gained thus concluding that negative attitudes towards CBL do not prevent students learning from this form of instruction. Students spent an average of three hours studying with the materials and this was considered appropriate by the authors though some students felt it was disproportionate to the grades they gained in the subject. It is not stated whether they felt this was too long or too short a time to spend studying. Some students omitted parts of the module and most often omitted was the pathophysiology of cancer, possibly because the students felt they already had this basic knowledge. It may have been, however, that this subject just did not interest them. The relationship between time spent on the materials and knowledge gained was not tested.

This study was repeated using similar web-based CBL materials for nutritional anaemia and diabetes (Buchowski et al. 2002). These materials also made use of on-line tutor support via e-mail. The results of this study could be directly compared with that of Kohlmeier et al (2000) as the methodology, measurement tools and materials were similar. Buchowski et al (2002) also found a knowledge increase of over 50% following use of the CBL materials and found most students retained the information 8 months later. A possible flaw is that the students in this study worked on the materials in small groups and although they were advised to take the tests individually they may have worked together as the tests were not taken under examination conditions as in the previous study. The results of the CBL groups' midterm examination were better than those of the previous years' students who had not used the CBL materials (Buchowski et al. 2002). It is not possible to conclude that this

improvement was directly attributable to the CBL materials, as the cohorts may have had very different compositions; a matched control group would have to be used to determine this as used by Dewhurst et al (2000). Buchowski et al (2002) noted a correlation between those who took more of the CBL tests and higher scores in the module examination; they suggest that the tests are an integral part of the learning process and students should be encouraged to make use of this feature of the materials.

These extensive and thorough studies support the use of self-study CBL materials in medical education. Studies with larger and more varied and ideally randomised cohorts would allow results that would be more generalisable. Further Nutrition in Medicine modules have been developed and these are now widely used by first and second year medical students in over one third of the medical schools in the United States (Kohlmeier et al. 2000).

Wharrad et al (2001) evaluated their CBL packages on cell biology with different cohorts of student nurses and a cohort of medical students. A questionnaire including Likert scales and qualitative open-ended response questions was used to guage student attitudes. Pre and post test scores and examined module assessment marks were also compared for those using CBL with those using conventional slide–based instruction. The CBL packages were fully integrated with the module teaching including lectures, practical sessions and tutorials. The rationale for developing these CBL materials reflected not only financial and institutional pressures but also came from a response to student module evaluations which had suggested that the slide sessions in particular could be more stimulating and required better feedback on

interpretation of the images. The CBL packages contained text and interactive images using hot spots, which were closely integrated, they also included exercises with feedback. The materials were delivered through the university's computer network but it is not clear whether they were based within a VLE. Information about which students had used the packages and how long they spent using them was also collected. No significant differences were found between satisfaction for the nursing and medical students and students were generally positive about the packages. A within-cohort comparison comparing the CBL packages with the slide session showed significant differences between the responses. The slide group were significantly less confident in applying the material for future use than the CBL group and also relied more on the contribution of the teacher. The between cohort comparison showed again that the CBL group tended to be generally more positive and again found that the CBL gave more confidence in future application of the material learned. The authors analysed the grades of the students in the module assessment over a 4 year period were the proportion of CBL use had been gradually increased and found that there was no significant difference in the mean grades over this period. This may indicate that the CBL is successfully replacing more conventional teaching of cell biology but again it is difficult to attribute the effects solely to the packages as delivery of the other elements of the module may also have an effect. The authors reported that taught hours had remained constant but did not say whether the delivery of these elements had also remained constant apart from the incorporation of the CBL packages. The mean marks for each of the packages after post-tests were compared to further determine the effect of the package on learning. The CBL group mean score was significantly higher than the slide group for the immunology package but there

was no significant difference between mean scores for the cartilage and bone package (Wharrad et al. 2001).

This study attempted to use a variety of methods to evaluate the effectiveness of CBL materials; the evaluations have supported the use of CBL packages by providing evidence of student satisfaction as well as learning gain in post-tests and no adverse effects on the module assessment. Evaluation of CBL materials in a controlled environment while scientifically desirable does not reflect how the packages will be used in reality but by using a variety of evaluation strategies it is possible to provide useful information about their benefits in real terms.

Studies on CBL materials incorporating video

In Britain videos have been used in a CBL package, which is part of a larger project, managed by the Joint Information Systems Committee. The project called LIFESIGN aims to develop, catalogue and evaluate the use of video streaming to support student learning in the life sciences in higher education. Green et al (2003) developed a module on life sciences, as part of the LIFESIGN project, to supplement the traditional teaching of this subject to first year nursing students. The cohort, unlike the previous studies, was very large at 656 students. These students had a broad range of age and experience and a wide geographical distribution over several campuses. The module was delivered through a virtual learning environment (VLE) and students had been given introductory sessions in how to use this. The on-line resources supported lectures, practical classes, tutorials and conventional library resources and contained directed learning activities which involved students accessing on-line resources and undertaking a directed activity. Three of the twelve topics covered used streamed

video clips of the immune, neurological and endocrine systems. These were embedded in the directed learning session through hyperlinks in word documents. The activities encouraged the students to engage with the video by answering set questions (with guideline answers provided later by lecturers), drawing diagrams from the information given in the video and making summary notes. Each directed learning session also included a series of self-assessment multiple-choice questions (MCQ's) but it is not clear whether these were directly linked to the videos. The evaluation focused on how effectively streamed videos supported student learning. Teaching and support staff contributed as well as students by sending reflective e-mails to the evaluator and taking part in a focus group. Students' use of the resources was monitored through VLE access. Each directed learning session with a video also contained three Likert style survey questions designed to evaluate students' perceptions of the value of the video. However watching the video and completing the questions was optional. Just over half (about 350) of the students played the video streams.

Green et al's (2003) findings revealed that although students had been taught how to use the VLE some lacked the skills required to successfully play the video clips. Some technological problems were experienced with accessing the videos through the VLE, but these were resolved, though accessing the clips from home was initially restricted in order to attempt to conform to licensing restrictions, even when it was permitted it was frequently slow and interrupted. Use of the MCQ's and videos peaked just before the exam. Staff were generally enthusiastic about the use of streamed videos and their embedding within the learning materials via the VLE but expressed their concerns about interrupted access. Fifty nine percent of students who

accessed the videos reported that they enjoyed using the learning materials including the videos but only 25% were very confident that they had learned from their use (Green et al. 2003). Unfortunately the study does not allow us to discover why nearly half of the students chose not to use the video clips. However it highlights the importance of introducing students to the specific learning tools designed for self-study before they are released. This could increase the number of students accessing the resource as they may be more confident to use it and should also prevent operative difficulties. Embedding of the materials within the VLE allowed the students in this study to access a wide range of materials. It also meant that they could choose their preferred mode of study, although in this study many of the students chose not to access the videos. Access to streamed video within most universities should be possible as the bandwidth of the academic networks is wide enough to accommodate this (Thornhill et al 2002) but until broadband networks are available throughout the country access from home will continue to be a problem for some students. This should not deter developers and researchers into this media as we can learn from our experiences and should endeavour to keep apace with the developing technology in order to provide "state of the art" resources for our students.

Bodemer et al (2004) identified a concern regarding the use of dynamic pictorial representations. While the use of multiple dynamic and interactive external representations have the potential to improve learning it is suggested they also place an increased demand on them in terms of cognitively processing this information (Bodemer et al. 2004). This assumption is supported by research based on cognitive load theory (Kirschner 2002) were it is important that material including dynamic pictorial representations e.g. animations or video should try to decrease extraneous

cognitive load while trying to increase germane cognitive load. Bodemer et al (2004) conducted a series of experiments to discover how best this might be achieved. Active integration of different representations by the students improved learning significantly and when this activity was structured it specifically increased verbal understanding of the material (Bodemer et al 2004). This is relevant to designers of CBL materials making use of multimedia; such packages should require students not only to watch these dynamic representations but to actively integrate textual and other related material. If activities are structured requiring them to demonstrate their understanding, this type of learning activity does not place too heavy a cognitive load on the students but may in fact enable the increase of germane cognitive load.

Video training was investigated by Bernhardt et al (2001) to discover whether it improved the accuracy of observational kinematic assessment of stroke by 51 physiotherapy students. Training and test videos were created and accuracy of assessment of components of upper limb movement was assessed. Three groups were compared, those who used the videos but had no feedback results of their assessments, those who used the videos with feedback and a control group. Observational kinematic assessment accuracy was found to improve in both groups who used the training videos but those students who had feedback (knowledge of results) had a greater reduction in error though this was not tested statistically. These improvements in observational skills also seemed to be retained (Bernhardt et al 2001).

These studies suggest the need for further investigation into the use of video to enhance the development of observational skills and understanding of related theory.

It seems that materials incorporating videos with text, requiring students to actively integrate these materials while being provided with feedback may have the most beneficial effects on their learning. Basing these materials in an e-learning environment will increase access to these materials and could further enhance the experience.

Studies investigating CBL materials within a Virtual Learning Environment

Madariaga et al (2003) evaluated the quality, quantity, accessibility, impact and user satisfaction with support materials on clinical biochemistry based within a VLE with 40 medical technology students. A questionnaire was used to investigate student satisfaction but as well as a four point Likert style scale they incorporated open ended questions to ask for suggestions regarding the improvement of the materials within the environment and the strengths and weaknesses of this mode of study. Student satisfaction relating to organising their learning, increasing motivation in the subject and the quality of the materials provided was high. The lowest percentage of students (63%) found access satisfactory although this is still over half of the cohort. Suggestions made by the students included extending it to other subjects and although they approved of its role in supplementing traditional teaching methods they were reluctant for it to replace these. A comment was made about the impersonal nature of this mode of study. There were some technological issues raised similar to those found in the previous studies. Comments were made which indicated that students had considered the wider benefits of this form of study; they felt it would raise the level of the course and that teachers had improved as result of the technology.

These findings add a new dimension to the factors we should consider when developing and evaluating e-learning. Although this study investigated a small number of students it is important as it reveals the value of asking for more open contributions from students when evaluating and improving e-learning. There are also few studies evaluating the use of VLE's in relation to supporting traditionally taught courses rather than for use in open and distance learning.

The only use of computer assisted learning using multimedia and underpinning practical skills in a campus based undergraduate physiotherapy course which could be found was a case study which is published on the Higher Education Academy web-site. However this study has been included in this review as it closely relates to the rationale which has motivated the development of this project. Robinson (2003) reports on the development and use of e learning materials on electrotherapy, which have replaced traditional teaching methods in an undergraduate physiotherapy course. She explains the rational for development of these materials being to enhance students understanding of physical sciences underpinning the practice of electrotherapy and also allowing access to materials for revision which are directly related to the practical requirements of the course. Use of the materials has also released contact teaching time for further practice of the application of electrotherapy to the clinical setting. The materials comprise text, interactive flash animations of how to operate electrotherapy machines, video and audio. Self-test questions do not appear to be included though mention is made of interactive content other than that related to the flash animation; however the exact nature of this has not been described. Students may use the computer based materials at any time as they are delivered by the Blackboard VLE though they are also encouraged to refer to them during practical

classes as well to allow them to reinforce their learning. Ongoing review of these materials is taking place and the study has been updated on the web site (Robinson 2003). The materials have not been specifically evaluated but feedback is gained from through the normal module evaluation questionnaire, which includes specific questions about the use of the VLE within modules. Tracking of student activity has also been possible through the VLE and shows that they are accessed regularly including evenings and Sundays. She has found that students have generally benefited from the use of the materials particularly in relation to revision. Interestingly students initially expressed a desire to try and print out all the materials irrespective of guidance from the tutor as to how to use the materials. The students are now however using the resources routinely as part of their module and are seen by the students as *"simply another tool rather than something special"*.

Further development and expansion of the materials has continued but the use of e-learning within the department has not necessarily increased as other staff do not have the skills or the time to develop these in order to extend these ideas. Interest in the project has mainly been in the learning product rather than the process but there has been some extension of the idea to other areas of the course such as anatomy. She notes that the content however is very subject specific. There are questions about the project that remain to be answered, such as the use of particular components and how they support the students' learning needs Robinson (2003). This study highlights that e-learning may be used effectively and inventively to supplement different aspects of campus based physiotherapy courses. There is a need to ensure that these materials are rigorously evaluated to enhance their continued development and effectiveness

and to discover whether materials designed for one particular course can be applicable to other health science courses.

Summary

Previous research indicates that e-learning is a fast developing educational technology. Studies would suggest that it is an acceptable means of instruction to students providing that adequate instruction is given in the required underpinning computer skills. The general effectiveness of this form of learning is still unproven but because of the course specific nature of the materials, establishing whether the materials achieve their desired outcomes within the context they are designed to be used probably best assesses this. Most of the materials which have been designed and tested relate to basic sciences, only one case study was found relating to CBL materials specifically designed for physiotherapy which was directly relevant to practice. The use of multimedia has great potential in providing resources, which are more stimulating and encompass the development of a wider range of learning styles. It is possible that this can also provide students with greater availability of resources that would otherwise be difficult to access. These newly developed CBL resources should facilitate interactive learning.

Using the VLE for delivery of CBL materials rather than basing them on a CD-ROM allows flexibility not just for learners but also for academic staff as materials can be regularly updated. The ability of these environments to monitor student activity is also useful for evaluation of the resource, as is the ability to submit evaluative communications conveniently from within the environment. Evaluation of these new learning tools should consider their use with different groups of students who will be

using them and use open ended questions to discover student attitudes including Likert type responses as used in most of the previous research. It would also be of benefit to test the students through assessment of their learning in the real environment rather than in a controlled situation to discover whether the CBL materials achieve their desired outcomes. This approach to evaluation, where CBL materials are evaluated by a number of means in the environment rather than in separate experimental conditions, has been discussed and described as integrative evaluation by Draper et al (1996). This method of evaluation provides teachers with relevant information about how the package is being used and whether it is achieving its desired effects thus allowing adjustments to be made to improve the learning environment. This type of evaluation is extremely useful during the developmental stages of a new learning intervention allowing the process to evolve in relation to the feedback received. Draper et al (1996) suggest this method also contributes to quality assurance procedures by providing further evidence about what is being achieved and demonstrates that quality is being actively monitored using extensive student based measures.

Literature suggests that computer based or e learning can be of educational value to students when designed with required learning outcomes in mind by improving access to materials enhancing the learning experience rather than just substituting a screen for paper (Honey 2000). The development of specifically designed materials to suit the outcomes and requirements of a particular module or course may be preferable to the use of "off the peg" e learning packages used as an add-on or optional extra rather than properly integrated into the course. These packages should be designed to facilitate cognitive processes (Bodemer et al 2004; Mayer 2003), develop broader

learning styles (Van der Velden G. 1999) and motivate students for self study (Race 1994) by using contiguous multimedia integrated with textual information. Packages should include self assessment to facilitate deep and constructivist approaches to learning (Cennamo & Dawley 1995; Kaufman 2003; Ward 1998). Previous research suggests that satisfaction with and use of e learning may differ depending on age, gender and year group (Hernandez-Jorge et al 2003; Richardson 2001). This evidence is limited and comparisons have not been made between age groups of students whose previous education did not include the widespread use of computers and those who have grown up with computers. Further evidence is also needed to discover whether females have more negative opinions than males towards e learning and whether specific aspects of the experience are valued differently in terms of age group and gender. Course groups have been compared in terms of attitudes to e learning but with different content and only in relation to the delivery environment i.e. VLE (Vuorela & Nummenmaa 2004). Comparisons have not been made between course groups with similar learning outcomes sharing the same e learning content and environment. Effectiveness of e learning should be established by an integrative evaluation (Draper et al. 1996) and judged on how well it achieves its intended objectives (Lewis et al 2001). Evaluation of e learning using multimedia has so far shown generally positive results. Problems with shallowness of material, installation and access out-with university have been sighted as reducing satisfaction and use of e learning materials (Bacro et al 1997; Bull et al 1998; Dewhurst et al 2000; Lyte & Kerr 1996). Recent advances in broadband technology may reduce these problems and this requires investigation. One evaluation made use of computer-tracking capabilities to investigate students' activity with e learning materials (Green et al. 2003) but the relationship between student activity and effect on learning has not been investigated.

Increasingly sophisticated means of tracking student activity may allow this relationship to be studied.

The aims of this project were therefore as follows;

Aims

1. To develop web based e learning packages to supplement the learning of students studying in campus based physiotherapy courses.
2. To evaluate these packages in relation to student attitudes towards computers and satisfaction with the packages in relation to achievement of development objectives.
3. To compare different course groups, ages and genders of students in relation to their opinions of the packages with a view to analysing themes and variations
4. To discover students' preferences in relation to types of delivery for Movement Analysis, Manual Therapy and Stroke.
5. To investigate the relationship between student activity with packages allowing student tracking and the effect on learning.

The developmental and evaluative objectives for each package are presented at the beginning of each relevant section in the methodology chapter.

Chapter 2. Methodology

Introduction

This chapter describes the development of the Movement Analysis, Manual Therapy and Stroke packages and the methods used to evaluate each package. All the packages, a sample questionnaire and the summative test versions can be accessed at any time by clicking on the link below or by typing it into the address bar in a web browser:

https://qm.rgu.ac.uk/q/perception.dll?name=shsvc?password=phd

The inspiration for developing computer assisted materials to support self study arose from the need for physiotherapy students to be able to practise their observational anatomical movement analysis.

Students are required as part of their module learning outcomes for Applied Anatomy to be able to:

- *Observe, analyse and describe normal functional movements using anatomical terminology.*

(Module descriptors Robert Gordon University BSc. (Hons) Physiotherapy 1999)

Physiotherapy students therefore have an underlying need to develop visual literacy and will continue to develop their observational skills as undergraduates and postgraduates using them to assess patients' problems and progress. These skills are usually taught in practical classes and assessed in a practical examination. A classmate acts as a model performing various activities, which the student observes, analyses and describes with feedback from the tutor. Students are then required to

practise this activity in their own time. However this study method presents several difficulties for the student. A model is required and may tire after several repetitions of the movement, producing minor changes in performance and invalidating the original analysis. If the students are practising in their own time, no tutor will be present and therefore appropriate feedback to that unique situation will be unavailable. Rowntree (1990) recognises that even in conventional instruction learners spend time learning on their own from existing materials such as books and journals but acknowledges that private study materials are rarely created specially for them with their needs and courses in mind.

Previously, videotapes had been made of a selection of normal movements, which could be used to practise observation and analysis. French et al. (1994) have emphasised the importance of skill practice and suggest the use of videos as an adjunct to individual practice out with teaching sessions. These videos had also been used with a paper-based answer sheet as an alternative means of assessment to the practical exam. This method standardised the assessment so that all the students were required to analyse the same movement and also reduced the possibility of slight changes as the model tires. This method of assessment required less staff and student time as all the students are able to sit the test simultaneously and the answer sheets are marked after submission. However as a method of self-study and assessment this method has several flaws.

- Individual students would have limited access to a tape-based video, even if multiple copies were held in a library.

- Paper based answers for each movement would have to be given in a booklet to accompany each video.
- Students would have to "mark" their own attempts against the answer booklet.
- There is no way of encouraging students to attempt to analyse the movement themselves without referring directly to the answers.

This latter problem could result in rote learning the answers to the individual videos, resulting in superficial learning and a lack of development of observational skills. If properly constructed, self-assessment activities can encourage deep learning as they enhance motivation to learn as this increases with early success. Self-assessment may take place in privacy to gain confidence before a formal exam and takes away the fear of the unknown. It enhances learning by doing through the application of criteria, decision making, judgement and reflection and avoids passivity. Learning is enhanced through feedback particularly if it is rich and immediate. Self assessment also allows digesting of information helping learners to make sense of the experience and feedback (Race 1993). In order to facilitate this type of self-assessment activity it was necessary to design a method of self-study and assessment which would allow students not only to access a library of functional movements but also to allow them to test their skills of observational analysis with meaningful feedback following their attempts. It was also desirable to ensure materials could be accessed for private study.

During the process of searching for a solution to this dilemma the possibilities of extending the design of such a learning tool to support the fulfilment of other learning needs and outcomes was also considered. In considering the potential designs of these packages it was important to consider not only the underpinning pedagogies

influencing this type of learning but also the different learning styles of students who would be using the packages.

Learning theories underpinning package design.

It was very important to ensure that the self learning materials were well integrated with students' existing module materials, allowing students to relate this activity to their existing knowledge and increase the chance of learning occurring (Lawton 1996). Spiro et al (1992) supports the interconnection of learning resources to allow students multiple exposure to required knowledge thus allowing the transfer of this knowledge to other situations, particularly when these materials are case-based. The self-study packages were designed using clinically relevant terminology and content, closely related and linked to existing module content, thus hopefully reinforcing the correct understanding and application of this knowledge. The packages were further integrated by accessing them in the same way as other module materials and introducing them as a timetabled session within the module teaching.

Knowledge transfer as described by Spiro (1992) promotes abstract thinking which, according to Piaget (1970), is the final fourth stage in fulfilling full cognitive development. However students who have not yet acquired a full grasp of the basic knowledge will not be able to achieve this cognitive level. Knowles (1990) recognises the importance of identifying gaps in students' knowledge but places some responsibility for this on the student. Computer-based self-study materials, unlike paper-based self-study, can allow students to receive immediate feedback. Computer-based feedback does however rely on the anticipated response from the student to the problem posed. Paper-based self-study relies on the student not accessing written

answers until they have completed the task or seeking tutor support to enable feedback regardless of whether this is written or verbal. Face to face feedback with the tutor has the advantage of being relevant to the particular individual needs of each student and for this reason the self-study packages and related feedback were not designed to replace face to face discussion of these topics but rather to supplement students' own study of these areas and stimulate further discussion in the practical classes. Feedback, in all forms, is vital in assisting the identification of knowledge gaps allowing remedial support to be given promoting students' achievement of their cognitive potential. The computer applications chosen to create the self-study packages were therefore investigated for their ability to provide timely, meaningful and relevant feedback.

The constructivist theories of Bruner (1966) support the concepts of developing cognition and meaning through forms of instruction which are contextual, allow transfer of knowledge and identify gaps in knowledge. Bruner (1966) suggests that instructional materials should also be structured so concepts are easy for students to grasp thus allowing them to fill in the gaps they have identified in their knowledge. Sweller et al (1998) conducted research suggesting that students were able to more easily "grasp" concepts if, in designing instructional materials, extraneous cognitive load is minimised. Mayer et al (2003) further investigated the design features which contribute to the lessening of extraneous cognitive load and suggests that materials are personalised, include multimedia and information sources are contiguous and do not contain extraneous information. These theories were used to underpin the development of the packages.

All the packages contain multimedia integral to the self-study activities, rather than added as a decorative distraction. Efforts have been made to use straightforward personalised language appropriate to the activity and to ensure that videos, questions and support materials are contiguous. Ironside (2005) warns that a cognitive approach to instructional design alone is insufficient, particularly when designing materials to support health related professional courses. She emphasised the importance of students exploring different clinical situations to support deeper clinical reasoning processes. Lave & Wenger (1991), Kelly (1999), Bahn (2001) and Kaufman et al (2003) discuss the importance of clinically relevant materials in linking theoretical teaching and learning to clinical situations supplementing cognitive learning with experiential and social learning. While computer-based learning cannot replace the experience of a clinical placement, material that is clinically relevant, provides insight into clinical scenarios and practice, of clinicians as role models. As this allows students repeated interaction with these materials, motivation to learn may be increased and fear of unknown expectations of clinical practice reduced. Taking these theories into account when designing the self-study packages should promote students' cognitive, experiential and social development, construction of meaning and ultimately their learning by increasing their transferable understanding and application of knowledge, allowing them to identify gaps in this knowledge and motivating them to fill these gaps.

Relationship of learning styles to package design

Honey (2000) suggests e-learning materials should make the most of their flexibility in accommodating different learning to avoid students becoming de-motivated when using them for self-study. The packages were designed to allow students with a

variety of learning styles to use them. While they incorporate both textual and visual sources of information it is likely those with visual and pragmatic learning styles will be mainly accommodated. Self-assessment questions have been worded and structured in a variety of ways to ensure that different learning styles are addressed and to encourage a deep approach to learning. Encouraging a deep approach may be achieved by asking students to demonstrate understanding, apply knowledge and solve problems (Entwistle et al 2000). Clinical questions should therefore ask students why a particular technique is used and how it may be safely applied and the packages themselves were designed to allow students to apply theoretical knowledge to practical situations through self-study. The provision of additional methods of study such as computer-based self-study packages will in itself broaden the learning experiences of students and extend choice thus accommodating a wider variety of learning styles.

Vittetoe (1983), Cavanagh et al (1995) and Wessel et al (1999) have investigated the learning styles of health science students but there is no consensus as to one preferred style for this type of student. Leuthold (1999) investigated the relationship of Gregorc learning styles to students preferences for computer-based learning and suggests that those with a sequential learning style prefer computer-based learning over those with random learning style. However she acknowledges that computer-based learning takes many forms (Leuthold, 1999) and thus studies of this nature can only reveal preferred learning style in relation to their particular mode of computer-based learning rather than computer-based learning in general. The reliability and validity of learning style instruments have been criticised (Bonham, 1988). Lyte and Kerr (1996) suggest that students' learning styles are not static and change in response to different learning

experiences and situations. It is possible therefore, that students with less preference for visual and pragmatic activities may be encouraged to develop these styles by interacting with these materials. It was not, however the purpose of this study to discover whether this was the case although following investigating whether these computer-based materials are an acceptable and effective means of self-study it may be useful to investigate how they are used with students of differing learning styles. Many learning styles instruments were developed before the advent of computer-based or e-learning and categories have therefore not been developed which take activities specific to this type of learning into account. More recent research (Van Dover and Boblin 1991; Richardson 2001; Hernandez-Jorge et al 2003; Vuorela and Nummenmaa 2004) has focussed on the potential effects of students' individual differences, such as attitudes to and confidence with computers, on their inclination to use and performance with computer-based learning materials. This study will therefore examine these differences in relation to the acceptability of the packages.

Rationale for the methodological design of the evaluation

Previous studies evaluating computer-based materials have used a variety of methods depending on whether the aims were to compare CBL materials to conventional learning materials or to illuminate the development of CBL materials. Early evaluations employed an experimental design measuring and comparing assessment scores following exposure to computer-based materials compared with those exposed to conventional materials to establish whether they were a realistic alternative to conventional teaching methods (e.g. Dewhurst et al 1998). Experimental design evaluations present various problems and practical difficulties. This type of study requires that one group of students is denied access to the computer-based materials in

order to act as a comparison or control group. This may result in these students feeling unfairly treated and the experimental group being unfairly advantaged. This could lead to a lack of volunteers for the study and small sample sizes, thus compromising the statistical analysis relied on to show effects in experimental studies. Students in the control group feeling disadvantaged may "cheat" by gaining access to the other group's materials thereby negating the comparison between groups. It may be impossible for the investigator to detect such activity but in controlling against this perceived risk, may force interaction with the learning materials to take place in an artificial environment, so compromising the external validity of the results. This ethical dilemma is particularly relevant if the assessment used as an outcome measure contributes to the summative module grade. However, if the assessment does not contribute to the module grade, students may not interact with the materials in the same way. Even if care is taken to ensure there is no sharing of materials between groups, the investigator cannot be sure that students' results, whether better, the same or worse than predicted can be solely due to the materials themselves and not due to other learning experiences outwith their control. Results may also be influenced by operational problems and mismatching of the materials to course objectives (Ellington et al 1995). These difficulties may have a resultant effect on the meaningfulness and significance of the results only allowing them to be relevant for that particular group of students using the materials in this artificially created scenario. Dewhurst et al (1998) recognise the disadvantages of this type of design and suggested that further studies should attempt to study CBL materials in the environment in which they were designed to be used while also investigating the opinions of students regarding the acceptability and usability of the materials.

Questionnaires have been widely used in studies investigating students' attitudes towards and opinions of CBL. Questionnaires allow the researcher to collect information from a larger sample of students than focus groups or interviews (Cohen et al 2000; Ellington et al 1995). Closed questions allow the researcher to code responses and readily compare the opinions and attitudes of different groups of students and Likert scales have effectively been employed to evaluate students' agreement with various statements about different features of CBL materials. The inclusion of open questions in a questionnaire allows greater depth of information to be collected. When used in conjunction with closed questions this information may illuminate the reasons behind anomalous responses and thus can be used to triangulate results. Interpretation of this information must however be carefully carried out so as not to introduce bias (Cohen et al 2000, Ellington et al 1995).

Draper (1996) supports the collection of information about student opinions in the evaluation of CBL materials. He suggests an integrative evaluation, involving a variety of methods, with students using the materials in the learning environment for which they were designed. While accepting that results of any evaluation of CBL materials in the real environment will only be relevant for those materials in that specific situation, the aim of this type of evaluation is to discover whether the materials are meeting their intended objectives. An integrative approach is very useful in the developmental stages of a new learning intervention allowing the packages to evolve in relation to the feedback received.

The aims of this study were not only to evaluate computer based learning materials but also to develop these materials to support the achievement of specific learning

outcomes. It was hoped that development and evaluation of the first package in this study would inform the design and evaluation of the further packages and therefore this integrative approach was adopted for evaluation. A questionnaire incorporating Likert scales and open-ended questions was used to elucidate students' opinions and attitudes regarding the packages and to allow comparison between different groups of students. A pre-designed questionnaire (appendix 7) was developed by the Learning Technology Dissemination Initiative (L.T.D.I.) at Herriot-Watt University. The questionnaire had been designed specifically for this use, making it a valid and reliable research tool. Questionnaires are a reliable and practical tool for collecting information about the opinions of a large number of subjects (Cohen et al 2000, Ellington et al 1995, Polgar & Thomas 2000). Closed Likert style questions were used to allow statistical analysis and comparisons to be made while results would be further illuminated by the addition of related open questions clarifying closed responses.

The software application used to create the packages records information about when students log in and out of the packages and their scores and tutors can access this data via a reporting facility. If students are asked to volonteer identification numbers on accessing the packages, individual student use can be tracked. To discover the effects of the packages on learning the students' time spent, number of attempts and self-study scores were monitored for the newer packages permitting this tracking. Student time spent and number of attempts with the self-study materials were also compared with each student score in a separate compulsory assessment designed to test their transfer of knowledge to new questions. All students were instructed to use the packages in the environment and manner intended in the package design. Few studies

have made use of student tracking and none to date have reported using this to compare students use of self-study packages with their self-assessment or test scores. This study therefore serves as a pilot, for the use of tracking, in evaluating students' self-study activity with CBL materials in the real learning environment.

It was decided to address the immediate need for the Movement Analysis Package and, through its evaluation, continue to develop these materials in light of the results and feedback gained from this evaluation.

The Movement Analysis Package

This section describes the Movement Analysis Package and how it was created. It also describes its integration into different health science courses and how the package was used and evaluated. It outlines how it was subsequently extended to provide a means of summative assessment.

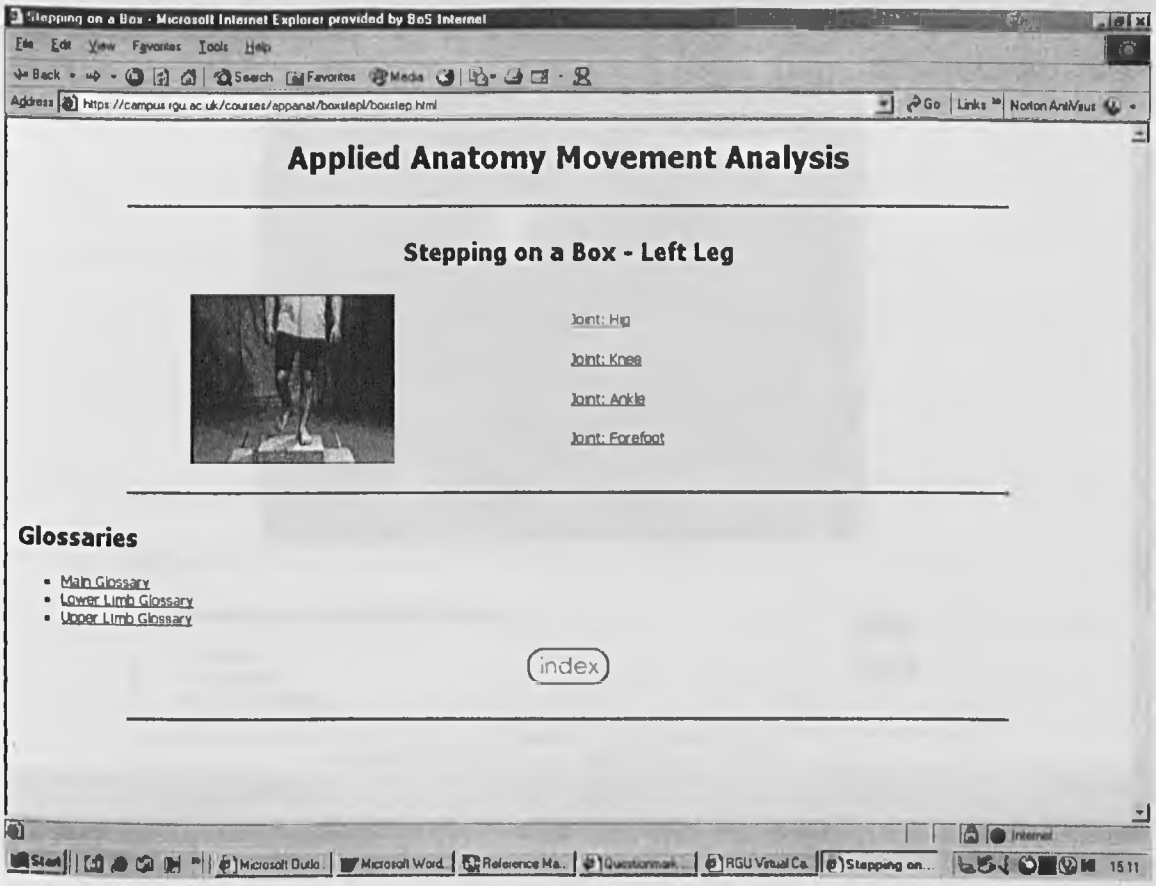
Development Objectives of the Movement Analysis Package

- To allow students access to a library of normal functional movements for observational analysis.
- To enable students to receive meaningful feedback on their attempts at observational movement analysis.
- To allow students to practise observational movement analysis in private out with the practical class setting.

The Movement Analysis package consists of web pages constructed in HTML and JavaScript with embedded MPG video clips. For the pilot version of the package these

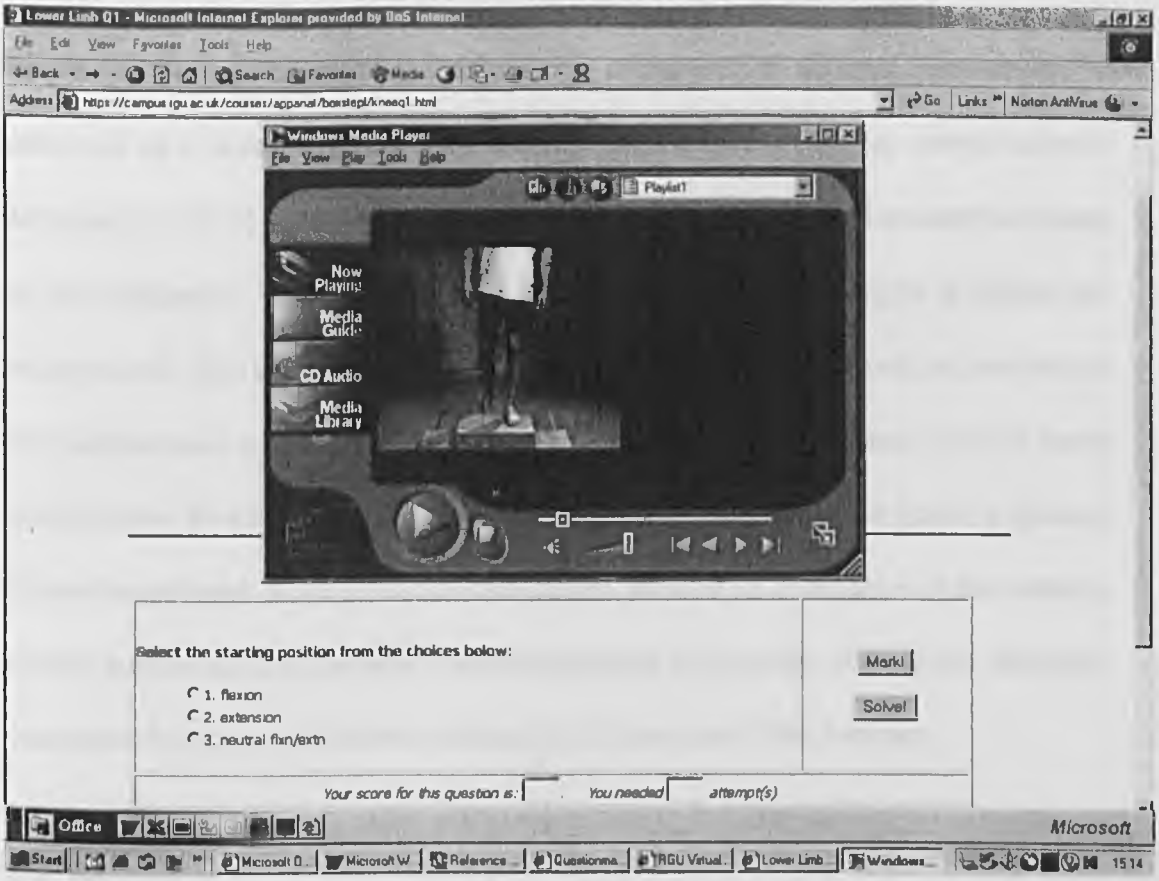
clips were captured from a videotape which had previously been used to provide students with an alternative means of observing and analysing functional movements using a paper based grid to record their answers. These clips were converted to MPEG and AVI format using an MPEG encoder. To extend the library of clips and allow consent to be given by the actors in the clips for their use in other courses it became necessary to film new digital videos which did not require this conversion. Students volunteered to model for filming of these clips and their informed consent was gained (Appendix 1 and 2). Question Mark Perception version 1 was used to create the pilot version of the package. This is a computer application, which supports the creation of customised on-line assessment questions. In addition to offering a variety of question types Question Mark Perception (QMP) also includes sophisticated reporting facilities, which can detail individual or aggregate scores, allowing for instantaneous feedback and tracking of student behaviour. As any HTML content may be combined with questions created by the application, hypertext links and multimedia content are easily incorporated. This enabled the linking of glossaries to the other pages to provide information to support feedback and study.

On choosing a movement to analyse, students are presented with a clickable link to the video clip that they can play, stop and start the movement at any time during the process.



SC1 showing the question index page of the Movement Analysis package.

Students are taken through each movement joint by joint and asked to identify the starting positions, intermediate positions (if applicable) and finishing positions from a list of choices which are presented in the form of multiple choice / response questions.



SC2 showing the question layout of the Movement Analysis Package

In the practical class they are taught to break down the activity into these components to facilitate identification of how the movement is being performed. Rather than presenting the student with just the correct choice and distracters it was decided that each list of answers should contain all the possible joint positions or muscles which could be involved in that movement. Students are then required to identify the muscles producing the movements and the type of muscle work used in the same way. Thus the virtual task mimics the reasoning process that the student should follow in the clinical setting as closely as possible.

Feedback is given following the submission of the answer to each question and is delivered as a score but may also include information about the correct answer. Milheim W. (1996) recommends interactivity in CBL packages and recommends easy to use navigation; interactive questioning and personally meaningful feedback are incorporated. Narciss S. (1999) studied the effects of CBL feedback on motivation and performance and found that greater informativeness of feedback leads to better performance. To allow students to find out more about the answers a link to a glossary is provided at each stage to enable the student to look up definitions of movements, muscle actions and attachments. Students accessed the package through the university computers by typing the Internet address (URL) into their Web browser.

The Pilot Study

A purposive sample of forty five second year physiotherapy students was recruited to pilot the Movement Analysis package (Cooper V. & McConnell M. 2000). Second year students were chosen for the pilot as they were deemed to have the necessary anatomical knowledge to use the tool and would also understand the context for its intended use. Students from a whole class were chosen to avoid the unrepresentative bias of asking for volunteers and to avoid those who may not have been chosen from feeling that they may be missing out (Harvey J 1998). Students excluded from this opportunity for self-study may feel disadvantaged and would need to be given an alternative form of self-study package to use. It would have been difficult to ensure that an alternative self-study method was comparable to the on-line package being tested. A crossover design where each student group used one form of self-study for a period after which they changed to the other form of self-study may eliminate any feelings of unfairness (Polgar & Thomas 2000). This more experimental method

would however create a less realistic environment in which to evaluate the package and may have elicited different types of comments from the students regarding the acceptability and effectiveness of the on-line package if they were comparing it to another form of self-study.

The students were given an introductory session on how to use the package and divided into four groups spending thirty-five supervised minutes using the MAP. This allowed adequate tutor and technical support to be given as required which reflects normal practice. Students would normally be given support from the tutor until they were confident enough to use the tool independently.

A questionnaire (Appendix 7) was administered to assess students' confidence and attitudes towards technology. The questionnaire was adapted from that designed and validated by the Learning Technology Dissemination Initiative at Herriot-Watt University to evaluate computer based learning packages thus increasing its construct validity in relation to its required purpose. Various studies have used questionnaires to elicit student attitudes to similar packages (Green et al. 2003; Madariaga et al 2003) . Attitudes about layout, navigation and content were assessed using Likert scales but open-ended responses were also included for further details and to accommodate unanticipated reactions and responses. Davidson and Goldfinch (1998) support the use of Likert scales for assessing attitudes and Milne (1998) suggests that standardised responses allow for more objective interpretation from a large sample but emphasises the importance of piloting to reduce the risk of misinterpretation. Richardson (1994) warns of the inattention of researchers to demographic characteristics such as age and gender and states that insensitivity to these variables

maintains existing inequalities in higher education. Demographic characteristics of the students are therefore included in the questionnaire with a view to discovering whether demographic variations in attitudes towards e-learning are similar to those found in other studies. Data was collected anonymously and informed consent (Appendix 3) sought from the students to take part in the evaluation. Cohen et al (2000) discuss the ethical considerations in educational research and suggest that privacy is ensured by anonymous collection and reporting of information as well as consent to take part. As also recommended by Cohen et al (2000) the dissemination of these results for academic research purposes was made clear to the participants as was the purpose of the study.

The results of the pilot study showed that the students had very positive attitudes towards the MAP. Some negative responses towards the quality of the videos were attributed to poor network performance during the course of one of the pilot sessions. Students identified the main advantages of the Movement Analysis package as being feedback, easy access and individual use. The main disadvantages were the problems with the network and logging in (Cooper & McConnell 2000). Results from this pilot study have helped to inform the development of the final questionnaire and suggestions made by the students have contributed towards the continued design of the packages.

Table P1. Summary table of students' attitudinal statements about the Movement Analysis Package

1=strongly agree, 2=agree, 3=neutral, 4=disagree, 5=strongly disagree

	1	2	3	4	5
Enjoyable to Use	7	26	10	2	1
Helps you learn about the subject	24	16	3	2	0
Worth the time spent on it	21	16	3	2	0
Would help me revise the subject	26	14	2	3	0
I would use it again in my own time	12	26	3	1	3
Will help me with future study in this discipline	16	22	2	4	0

Students were also asked for their ideas for improvements or any other comments. The most commonly made suggestions and comments are summarised as follows:

- Have the correct answers provided (16%)
- Group the muscle choices (11%)
- Package is beneficial to assist in learning the subject and prepare for the exam (22%)
- Good idea (16%)

Although these results were promising, success of the tool would depend on its effective integration into the modules it was intended to support. The Movement Analysis package was adjusted to improve its performance as suggested by the pilot study so that scoring would give more information about the incorrect and correct responses. This necessitated a re-design of the package using HTML and JavaScript

rather than version 1 of Question Mark Perception. The first page is the table of contents with links to instructions on how to use the package, together with the menu of normal movements to analyse and links to the glossaries. Students can stop and start the videos clips in exactly the same way. Feedback is given as the student submits the answer to each question in the form of a pop up box containing information about which responses are correct, which are not and the correct answers. A disadvantage of this was that any method of tracking student activity with the package was lost. However this facility in QMP version 1 failed to produce the required reports when used in the pilot study.

A full-scale evaluation of the new version of the package following integration to the relevant modules was carried out. The questionnaire was deemed to be satisfactory for the collection of the required information. In order to direct the students to give more definite opinions and to aid interpretation of the results it was decided that for future evaluations the neutral response category in the Likert scale would be removed (Cohen et al 2000; Percival et al 1993).

Integration and Evaluation of the Movement Analysis Package

Evaluation Objectives for the Movement Analysis Package

- To discover students attitudes towards computers.
- To discover students attitudes towards the Movement Analysis package.

- To compare the attitudes of different age groups, genders and course groups of students towards the Movement Analysis package with a view to analysing themes and variations.
- To discover students' preferences in relation to types of delivery for Movement Analysis.

The two student groups initially recruited were first year BSc (Hons) Physiotherapy (PT) students and first year MSc (pre-registration) PT students studying Musculo-skeletal modules. The learning outcomes of these courses require the students to:

- *Analyse static postures and dynamic activities, relative to joint movements, muscle actions and tissue loading.*

(Robert Gordon University Module Descriptors for BSc (Hons) Physiotherapy 2002)

It was anticipated that the MAP might be of value to other disciplines where knowledge of normal anatomical movement is required. Therefore second year BSc Hons Occupational Therapy (OT) students studying the upper limb anatomy module also agreed to evaluate the package so results could be compared between the groups. These groups constituted the 2002 cohort.

The students were introduced to the package early in their modules by the staff teaching that module in a timetabled supervised session. They were then given time on their own to use the package as an adjunct to their other means of instruction in the subject. It was thought that this related to the real learning environment and how the students should use the package. Dewhurst et al (2000) identified this as a weakness of the first evaluation they conducted as the package was evaluated in a tutor-

supported environment when it was actually designed to be a stand-alone self-study package.

To evaluate the Movement Analysis Package these three groups of students were asked to complete the evaluation questionnaires in sessions set aside for this activity at the end of their relevant modules. The BSc (Hons) PT students submitted 20 completed evaluations and the BSc (Hons) OT students submitted 25 completed evaluations. The MSc (pre-reg.) PT course started after an on-line version, identical to the paper form, was available and this group had the option of either method of evaluation. The 16 students in the MSc (pre-reg.) PT group all completed the on-line form.

Focus groups

Following the pilot study (Cooper V. 2000) it was noted that few further comments were added by the students to the questionnaire. It was decided to conduct focus groups to overcome this. Focus groups are an ideal way of establishing how to proceed with changes and informing developments with the opinions of those who are likely to be affected (Krueger & Casey 2000). The BSc (Hons) PT and MSc (pre-reg.) PT groups were asked for volunteers to take part in the focus groups. The BSc Hons OT students were unavailable for this activity.

The aim of this group was to discover students' opinions of the MAP and their views on the development of further CBL materials to best support learning for their course.

Eight BSc Hons PT students and three MSc (pre-reg.) PT students volunteered. A question schedule was drawn up for the groups (Appendix 4) as recommended by Krueger R. et al (2000) and piloted on 2 volunteer fourth year BSc (Hons) PT students proving satisfactory for collecting the required information. Each focus group was then conducted in a quiet room, facilitated by the researcher and the conversation taped and transcribed exactly.

Combined Results of the Focus Groups held with BSc (Hons) Physiotherapy and MSc (pre-registration) Physiotherapy students.

The main findings of the focus groups are presented here as they informed the continuing development and evaluation of the MAP and the further packages (Cooper & Ogilvie 2003).

The themes emerging from the focus groups were;

- Computers too few and too sluggish resulting in many having to rely on home computers.
- Generally opinion was that the package was worthwhile but would also like links to pathologies and treatments.
- Preferred access from home rather than having to stay in university after a long day.
- Generally positive towards package but felt that more guidance would be of benefit on how and when to use it, with more back up if confused about answers.

The department moved to a new site in 2003 with new computer facilities which it was hoped would overcome some of these problems. The package itself would now be hosted on the faculty Intranet (iNet) enabling students to access the package from home via a web link and allowing it to be fully integrated with the other module resources.

To allow further support when greater explanation was required a link could be made within the iNet to an on-line community group to allow students using the package and members of the teaching team to share views, which would afford a solution. It was anticipated that this community group would also allow students to provide further informal feedback about the package in an immediate, recordable and convenient way. A summary of students' comments in the community groups can be found in appendix 6.

Continuing Evaluation of the Movement Analysis Package

The subsequent cohort of students to use and evaluate the MAP consisted of BSc (Hons) PT students MSc (pre-reg.) PT students and BSc (Hons) Sports and Exercise Science (SES) students. A change in the structure of the BSc Hons Occupational therapy course meant that there was no longer a suitable module in which to integrate the Movement Analysis package. The Kinesiology and Biomechanics module within the new BSc (Hons) Sports and Exercise Science course has the following learning outcomes:

Learning outcomes

- *Analyse the joint movement and muscle work of simple activities*

- *Describe the biomechanical components of selected activities*

(Robert Gordon University Module Descriptors BSc (Hons) Sports and Exercise Science 2003)

It was therefore seen as advantageous to the students to use the Movement Analysis package to support their study of this subject. The assessment of these learning outcomes for this student group is also by a computer based movement analysis, which incorporates questions on related biomechanics.

The package was again introduced to each student group early in the relevant module in a timetabled, tutor supervised session. The students were then directed to use the Movement Analysis package as they required during the course of the module by each teaching team. The Movement Analysis package for this cohort of students was supported by an on-line community group for each module to act as support and informal feedback. These student groups completed the same on-line questionnaires as the previous cohort in a further timetabled session at the end of their modules. One could argue that these differences between deliveries of the package for the pilot cohort and following groups of students could jeopardise interpretation of the evaluation results. However, as Gunn (1998) recommends, evaluation should now be part of an on-going process feeding back into the loop of "implement, evaluate and improve" allowing appropriate analysis which is driven by the purpose of the evaluation. As the purpose of the evaluation in this case was to inform the continued development of the packages it was considered important to act on the results of the previous evaluation and the advances in technology to improve the learning experience for the students.

Development and Integration of the Manual Therapy Package

This section will describe the Manual Therapy package and how it was created. It will also describe its integration into both the B.Sc. (Hons) and MSc. (pre-reg.) physiotherapy courses.

The pilot study and focus groups held as part of the evaluation of the Movement Analysis package revealed that students felt it would be useful to have a similar package which allowed their self study of patient treatment techniques and in particular Manual Therapy.

Student quotes from focus groups;

"The notes we get from J. they have the photos of her actually performing the technique but if they're [manual therapy techniques] interactive on the computer you could actually see what she's doing, it would enhance the stuff you get, just getting a few integrated techniques, mobilisations."

"We're all so wary about the spine in class even people are not wanting to do it on one another and that area will need more attention."

"You could apply audio stuff to it as well couldn't you, so you could have something like the movement analysis package but have perhaps J. speaking in the background saying you apply the pressure..."

The learning outcomes for the M.Sc. (pre-reg.) PT module in Musculoskeletal Therapy require the students to:

- *Analyse, interpret and record data related to musculoskeletal assessment.*
- *Perform and justify the use of procedure in the assessment and treatment of the musculoskeletal system.*

- *Discuss and evaluate the range of management options for selected musculoskeletal conditions*
- *Perform safely a variety of physiotherapy techniques and modalities for musculoskeletal conditions.*

The learning outcomes for the B.Sc. (Hons) PT module Musculoskeletal Assessment and Treatment 2 require the student to;

- *Perform, document and analyse an appropriate peripheral and/or spinal musculoskeletal assessment.*
- *Select and apply manual/mechanical therapy techniques and principles safely.*
- *Discuss the management and treatment of patients utilising the different concepts of manual/mechanical musculoskeletal therapy.*
- *Demonstrate an understanding of the precautions, indications, modifications and contraindications to manual/mechanical musculoskeletal therapy.*

(Robert Gordon University Module Descriptors 2005)

The development objectives for the Manual Therapy package were therefore as follows;

Development Objectives

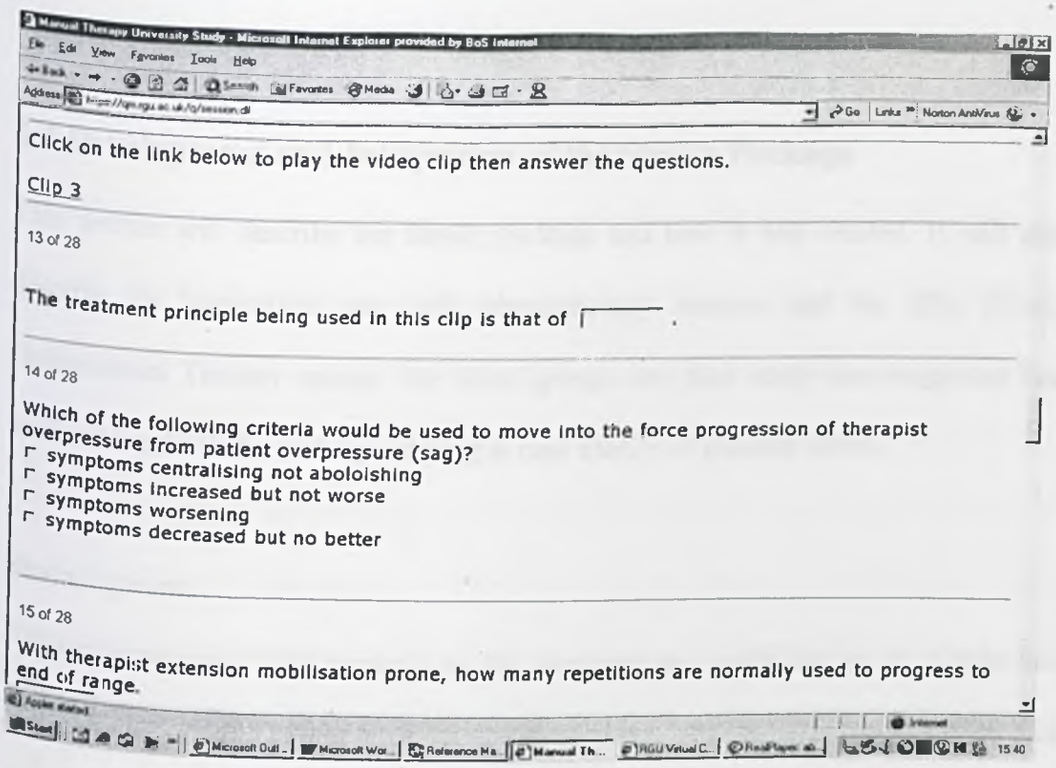
- To allow students to visualise and learn the correct application of manual therapy techniques out with the practical class setting.
- To enable students to consolidate their understanding of the use of these techniques with patients.
- To allow students to test their knowledge of the application and use of manual therapy techniques including assessment and safety issues.

Design of the Manual Therapy Package

The Manual Therapy package consists of instructional videos and self-assessment questions on two different manual therapy techniques; Maitland mobilisations and McKenzie exercises (Maitland 2001; McKenzie 2003). The application Question Mark Perception version 3 has been used to embed the videos and create the questions and feedback. Bull et al (1998) developed a distance learning package for midwifery students on the foetal skull and used an earlier version of this application (Question Mark Designer) to create their self-assessment materials. Following their evaluation they found that the students found this method of study enjoyable and felt it enhanced their learning. They commented that the limitations of the software at the time may have lead to the design rather than the content of the questions being a little simplistic (Bull et al 1998). The most recent version however, allows for greater ingenuity in question design and the incorporation of multimedia. The multimedia department at Robert Gordon University filmed students and a member of teaching staff whom again volunteered and gave their consent to be filmed. The videos were filmed using a digital camera and edited into streamed clips. Video streaming allows for a higher quality of video clip than those used in the movement analysis package (Thornhill et

al 2002). The videos are embedded in the self-assessment tests as an HTML hyperlink.

The videos show the lecturer demonstrating and talking through a series of manual techniques on the live model and also on a skeleton spine. It is hoped that this will not only allow the students to revise and practice their techniques but also aid their understanding of how each technique affects the movement of the spinal joints. The questions relate to the video clips and cover assessment, treatment application and safety factors in the use of each of these manual therapy techniques. They were designed and written with advice and peer review from members of the module teaching teams who are experts in this field of clinical practice.



SC3 showing sample questions from the Manual Therapy package.

Integration of the Manual Therapy Package

Students in both the BSc (Hons) PT and MSc (pre-reg.) PT groups access the package through the R.G.U. iNet along side supporting module resources. It is again linked to a community group for each module to allow for queries and informal feedback. The students are introduced to the package at the beginning of the module in a timetabled session but instructions are also given on-line within the module resources and students are advised to access it more than once. The module teaching teams refer to the package during the course of their practical teaching, reminding the students to use it.

2.4 Development and Integration of the Stroke Package

This section will describe the Stroke package and how it was created. It will also describe its integration into both physiotherapy courses and the BSc (Hons) Occupational Therapy course. The focus groups and pilot study also suggested that students would find a package relating to case studies of patients useful.

Student quotes;

"If they gave you a little scenario on the computer you could just go in. It'd be like your patients coming in and have like the age of them and see what you would do and how."

"Its getting quite close to our placements everyone was like panicking and thinking, when I get a patient will I know what treatment to give them?"

"It's the fact we might go out and not actually think you know anything
We've had so much information you don't feel as if you've processed it
They just go there's your patient and you go Oh! You don't know what to expect really. You don't want to hurt patients."

"You probably do know how to treat them but then you might not think and they'll [clinical supervisor] tell me and you'll think well I knew that but I just didn't relate it. The nerves will get to you."

"Its good just to see what you actually do, a day in like each patient, what a physio would do. It helps you think about it, less scary anyway."

It was felt that the first package to support learning of dysfunctional movement analysis should be based on Stroke. Assessment and treatment of this type of neurological condition requires a high level of observational skill (Bernhardt et al 2001). The Neurology module is delivered at the beginning of the students third year in the B.Sc. (Hons) Physiotherapy and Occupational therapy courses and in the third semester of the first year of the two-year MSc (pre-registration) physiotherapy course. At this stage some students may have seen patients with these conditions on clinical placement but most will not and therefore have difficulty in visualising the clinical presentations of these types of conditions. Following their clinical placements, students have reported that they find this experience of value in helping them to visualise the symptoms, presentation and problems of patients with various conditions when they come to study them in greater detail later in the course. Previously during the neurology module, students had visits to the stroke rehabilitation unit at the hospital to observe the assessment and treatment of patients with this condition. The number of students taking this module has increased from around 25 to approximately 64 rendering these visits unsustainable for the hospital staff and patients. It therefore seemed vital to provide these students with an alternative means of visualising this condition which is possibly the most common type of neurological condition they will be required to treat as practitioners, the incidence of stroke in the U.K. being about 1 in 500 (Honan 2004). It was therefore decided to make the first "Virtual Patient" a video case study of a stroke patient.

The BSc (Hons) PT and OT shared Neurology module requires students to;

- *Relate the structure of the nervous system to its overall function and relate the pathological changes within specified neurological conditions to presenting clinical features.*
- *Demonstrate an awareness of normal movement and its relevance in the assessment and treatment of clients with neurological conditions.*
- *Describe and demonstrate practically the approaches and techniques applied by their specific profession in the managements of clients with neurological conditions.*

The MSc (pre-reg.) PT module in neurological rehabilitation requires students to;

- *Discuss the normal functions of the central nervous system and the common clinical features which may arise from delayed development or deficit of the central nervous system.*
- *Discuss common complications which arise from disorders of the central nervous system.*

Identify and perform appropriate techniques for assessment and treatment used in neurological rehabilitation.

The development objectives for the Stroke package were therefore as follows;

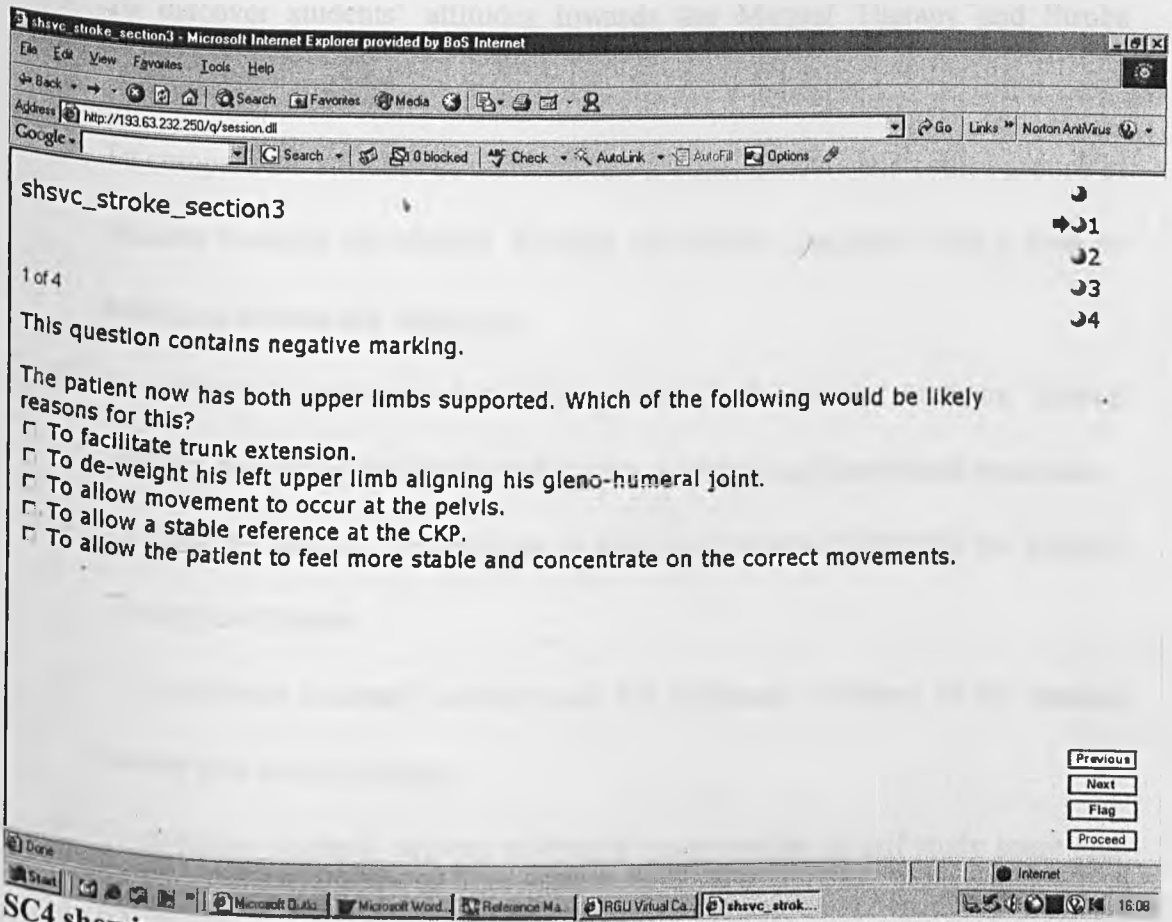
Development Objectives

- To allow students to visualise the clinical features of a typical patient who has suffered a stroke.
- To allow students to visualise techniques used in the assessment and treatment of a typical patient who has suffered a stroke.
- To enable students to consolidate their understanding of stroke and the use of these techniques with patients who have suffered a stroke.
- To allow students to test their knowledge of stroke and the techniques used in the assessment and treatment of patients who have suffered a stroke.

The Stroke package is similar in design to the Manual Therapy package and is also accessed in the same way through the RGU iNet. The video filming however presented different challenges, as a patient who had suffered a severe stroke was the subject of the video. It was therefore necessary, not only to gain his consent (Appendix 1 and 2), but to also acquire the approval of his next of kin and his consultant physician to ensure he was medically fit enough to take part. Two chartered physiotherapists and a physiotherapy helper were also filmed and their consent gained (Appendix 1and 2).

The video depicts an entire assessment and treatment session of the patient in lying, sitting and standing. Various views were filmed so that students would be able to see the patient in as similar a manner as possible to real life and close ups were also taken to allow for greater visibility of muscle and body contours. The patient was required to be dressed only in shorts, as he would be for his usual physiotherapy session, and care was taken to maintain his dignity and decency. The finished video was edited

into a series of short clips and each was embedded using HTML in the self-assessment tests created with Question Mark Perception version 3. The questions were again designed and written with advice and peer review from the module teaching team who are experts in this clinical field.



SC4 showing sample question and navigation layout of the Stroke package.

The tests are also linked to fictitious case notes and investigations such as a Computerised Tomography (C.T.) scan. Instructions, other study materials, and a revision test on the related pathology of the condition are also provided. The students are again introduced to the package in a timetabled, supervised session at the beginning of the module. They are reminded to use the package throughout the module and are provided with a link to a community group for each module to allow for queries and informal feedback.

Evaluation of the manual therapy and stroke packages

Evaluation objectives for the manual therapy and stroke packages.

- To discover students' attitudes towards computers.
- To discover students' attitudes towards the Manual Therapy and Stroke packages.
- To compare the attitudes of different age groups, genders and course groups of students towards the Manual Therapy and Stroke packages with a view to analyzing themes and variations.
- To compare the attitudes of students towards the Movement Analysis, Manual Therapy and Stroke packages with a view to analyzing themes and variations.
- To discover students' preferences in relation to types of delivery for Manual Therapy and Stroke
- To investigate students' activity with the self-study versions of the manual therapy and stroke packages.
- To compare students' activity with their improvement in self study score and test scores

A similar on-line questionnaire employed to evaluate the Movement Analysis Package (appendix 8) was used to evaluate both the Manual Therapy and Stroke packages. The statement relating to the glossaries in the Likert scale evaluating attitudes to features of the package was removed. The statement:

"The package provides good advice on how to work through the material."

was removed as students were given this advice in the introductory sessions by the tutor and re-enforced by the module team rather than provided specifically as part of the package.

The statement:

"I would use it again in my own time."

was removed as students were advised to use the package throughout the related modules in their own time and the extent to which they accessed it was now to be measured through the tracking information. Two new statements were added to the scale which were felt to be appropriate replacements for the removed statements and more appropriate to the Manual Therapy and Stroke package evaluations. These were:

"I feel more confident to computer assisted study materials."

"It has allowed me access to a useful resource."

In order to ensure the construct validity of the questionnaire was not compromised the added questions simply replaced those, which had been removed within the same question category but were considered more relevant to these new packages and the context in which they would be used (appendix 8). Care was taken during comparison of the packages to ensure that only features of this Likert scale common to both evaluation questionnaires were included.

All groups of students evaluating the Manual Therapy and Stroke packages took a previously unseen test version of the package. This consisted of questions similar to those in the self-study version of the packages both in content and style. These tests can be accessed at:

https://qm.rgu.ac.uk/q/perception.dll?name=shsvc?password=phd

The reporting facilities in Question Mark Perception allow student tracking of how the resources are used and scores from the students self study attempts can be compared to their test scores to see if there is a correlation between the use of the package and the students test score. This type of correlational study has been described by Cohen et al (2000) as allowing the researcher to ask three sets of question about two variables. Is there a relationship between them, if so, in which direction does this occur and what is the magnitude? It was intended through this method to test the following hypotheses relating to each of the Manual Therapy and Stroke packages;

Null Hypotheses;

1. There is no statistically significant linear relationship between the amount of time the student uses the package and the students' summative test score.
2. There is no statistically significant linear relationship between the number of attempts and the students' summative test score.
3. There is no statistically significant linear relationship between the amount of time the student uses the package and the students' improvement in self-study score.
4. There is no statistically significant linear relationship between the number of attempts and the students' improvement in self-study score.

Alternate Hypotheses;

1. There is a statistically significant linear relationship between the amount of time the student uses the package and the students' summative test score.

2. There is a statistically significant linear relationship between the number of attempts and the students' summative test score.
3. There is a statistically significant linear relationship between the amount of time the student uses the package and the students' improvement in self-study score.
4. There is a statistically significant linear relationship between the number of attempts and the students' improvement in self-study score.

The Stroke package is delivered in four sections and therefore statistical tests are carried out separately on each section. The subordinate hypotheses for each Stroke package section are included in appendix 5. Should more than two out of the four sections of the Stroke package show a statistically significant linear relationship (i.e. greater than or equal to 75% of the package shows a statistically significant linear relationship) it is proposed that this will suggest rejection of the overall null hypotheses for the Stroke package.

Chapter 3 Results

Introduction

The following chapter presents the results of the evaluation of each package. The first section details the Movement Analysis Package, which was evaluated solely by means of the evaluation questionnaire. Demographic information regarding the evaluating groups is detailed initially. Information from the various Likert Scales and ranking of preferred mode of delivery is then presented using tables and descriptive statistics. Likert scale responses and ranks were coded to allow calculation and analysis using SPSS. These scales provide ordinal data and therefore the median value is used to describe average responses. The median value refers to the code used for this response and a key to the response code is provided for each scale. Variables were tested for normality using the Kolmogorov-Smirnov test and were found mainly not to be normally distributed therefore non-parametric testing was carried out.

Student attitudes towards this package are compared between age, gender and course groups and tested statistically using non-parametric Mann Whitney U and Kruskal Wallace tests. Significance is tested at the 0.05 level unless otherwise stated.

The answers to the open comment questions are presented in the final section of the Movement Analysis Evaluation. The thematic analysis of these comments is summarised in tables followed by example quotes illustrating responses received in each category or theme.

The second section presents the results of the Manual Therapy evaluation, detailing the questionnaire results in the same way as the Movement Analysis Package and followed by an analysis of the data collected by tracking student activity. This

quantitative data is presented using tables and descriptive statistics. The following relationships between the data were explored and analysed for correlation using a Spearman's Rho Correlation Coefficient.

1. The number of attempts in the self-study version and the improvement in score.
2. The amount of time spent using the self-study version of the package and the improvement in score.
3. The number of attempts in the self-study version and the test score.
4. The amount of time spent using the self-study version of the package and the improvement in score.

In the third section the results of the Stroke evaluation questionnaire are presented as in the previous sections. The quantitative data acquired by tracking student activity is presented, explored and analysed in the same way as the Manual Therapy package.

The final fourth section summarises the Likert Scales, open responses and quantitative data for all three packages to allow comparison between them.

Section 1 Movement Analysis Package

Demographic information

The numbers of students in each group, their ages and genders are presented in the following tables.

In all six groups of students used and evaluated the Movement Analysis Package. These groups comprised the following numbers of students:

Table 1.1 Groups of students evaluating the Movement Analysis package.

Group	Number of students in year	Students completing evaluation
1. BSc Hons PT 2002	47	20 (43%)
2. BSc Hons PT 2003	46	29 (63%)
3. BSc Hons OT 2002	30	25 (83%)
4. MSc PT 2002	21	16
5. MSc PT 2003	23	22
6. BSc Hons SES 2003	13	12 (92%)
Total	180	124

The largest group of students evaluating the package was the BSc (Hons) Physiotherapy 2003-year group and the smallest was the BSc (Hons) Sports and Exercise Science 2003-year group.

The gender distribution of each group was as follows:

Table 1.2 Gender distribution of students per group.

		Group						Total
		BSc Hons PT 2002	BSc Hons PT 2003	BSc Hons OT 2002	MSc PT 2002	MSc PT 2003	BSc Hons SES 2003	
Gender	Male	1	3	3	8	4	7	26
	Female	19	26	22	8	18	5	98
Total		20	29	25	16	22	12	124

There were 98 female students and 26 male students who evaluated the movement analysis package. The MSc Physiotherapy 2002-year group had an even distribution of male to female students and the BSc (Hons) Sports and Exercise Science 2003-year group had a greater ratio of male to female students but all other groups had a greater ratio of female to male students.

The age distribution of the students in each group was as follows;

Table 1.3 Age distribution of students per group.

		Group						Total
		BSc Hons PT 2002	BSc Hons PT 2003	BSc Hons OT 2002	MSc PT 2002	MSc PT 2003	BSc Hons SES 2003	
Age	27 and under	19	24	23	12	19	11	108
	28 and over	1	5	2	2	3	1	14
Total		20	29	25	14	22	12	122
Percentage of mature students per group		5%	17%	8%	14%	14%	8%	11%

108 students aged 27 and under and 14 students aged 28 and over evaluated the Movement Analysis package. In all groups there was a higher number of students age 27 and under, only 11% of students overall being 28 years or over. The BSc (Hons) Physiotherapy 2003-year group had the highest proportion of students age 28 years or over.

Likert scale responses and ranking of delivery modes.

This section reports student attitudes towards computers, confidence in various computer-based activities, and attitudes towards different features of the Movement Analysis package, which were elicited using Likert scales. Students were also asked to rank their preferred modes of delivery for learning about movement analysis.

Attitudes towards computers were as follows. Agreement with the following statements was considered to indicate a positive attitude towards computers.

- Anyone can use a computer.
- Computer Literacy will make me more employable

Agreement with the following statements was considered to indicate a negative attitude towards computers.

- I find a computer difficult to use.
- Computers isolate you from other people.
- I am afraid of looking silly if I make a mistake while using the computer.

Table 1.4 Attitudes towards computers.

Statements about Computers	Total response	Level of Agreement			
		Strongly disagree	Disagree	Agree	Strongly agree
Anyone can use a computer.	(*n*=120)	2 (2%)	4 (3%)	72 (60%)	42 (34%)
I find a computer difficult to use.	(*n*=115)	40 (35%)	60 (52%)	13 (11%)	2 (2%)
Computers isolate you from other people.	(*n*=111)	22 (20%)	72 (65%)	17 (15%)	0
Computer literacy will make me more employable.	(*n*=120)	0	1 (1%)	66 (55%)	53 (44%)
I am afraid of looking silly if making a mistake while using the computer.	(*n*=117)	34 (29%)	69 (59%)	12 (10%)	2 (2%)

(*n* = total number of students responding to each scale)

Students exhibited mainly positive attitudes towards computers with 114 (94%) agreeing or strongly agreeing that anyone can use a computer, while 119 (99%) agreed or strongly agreed that computer literacy will make them more employable. The majority also disagreed or strongly disagreed that they found computers difficult to use (100, 87%) that they isolate you (94, 85%) or that they were afraid of looking silly making a mistake while using the computer (103, 88%). However 15% of students did agree that computers isolate you from other people.

Table 1.5 Key to response codes for attitudes towards computers.

Response	Code	
	Positive statements	Negative statements
Strongly Disagree	1	4
Disagree	2	3
Agree	3	2
Strongly Agree	4	1

For all statements the median value was 3 indicating that on average students agreed with the positive statements and disagreed with the negative statements about computers.

Students' responses to their level of confidence with different computer based activities were as follows;

Table 1.6 Confidence in computer based activities.

Computer based activity	Total response	Level of confidence				
		No confidence	Little confidence	Some confidence	confident	Very confident
web based	(*n*=124)	2 (2%)	4 (3%)	16 (13%)	55 (44%)	47 (38%)
Navigating materials on-line	(*n*=123)	3 (2%)	7 (6%)	25 (20%)	52 (42%)	36 (29%)
reading on-line	(*n*=124)	3 (2%)	7 (6%)	27 (22%)	54 (44%)	33 (27%)
Using multimedia	(*n*=124)	4 (3%)	20 (16%)	43 (35%)	38 (31%)	19 (15%)
Independent study	(*n*=124)	2 (2%)	4 (3%)	28 (23%)	50 (40%)	40 (32%)
self study	(*n*=122)	1 (1%)	3 (3%)	29 (24%)	53 (43%)	36 (30%)

(*n* = total number of students responding to each scale)

Students identified that were mainly confident or very confident in web-based activities (102, 82%), navigating materials on line (88, 72%), reading on-line (87, 70%), studying independently at the computer (90, 73%) and using computers for self study (89, 73%). Only 57 (46%) students who evaluated the movement analysis package were confident or very confident in using computer-based multimedia.

Table 1.7 Key to response codes for confidence in computer-based activities.

Response	Code
No Confidence	1
Little confidence	2
Some confidence	3
Confident	4
Very confident	5

The median values for all statements apart from using computer-based multimedia were 4. This indicated that students tended to be confident with these activities but a median value of 3 for computer-based multimedia indicates that students tended to only have some confidence in this activity.

Students' attitudes towards statements about the movement analysis package are as follows. Agreement or strong agreement with each statement was considered as a positive attitude to that feature of the package. Strong disagreement or disagreement with each statement was considered a negative attitude to that feature of the package.

Table 1.8 Students' attitudes towards the movement analysis package.

Statements about the package	Total response	Level of Agreement			
		Strongly disagree	Disagree	Agree	Strongly agree
It is clear what options are open to you at each stage.	(*n*=111)	1 (1%)	4 (4%)	89 (80%)	17 (15%)
It is easy to navigate to where you want to go.	(*n*=115)	1 (1%)	13 (11%)	81 (70%)	20 (17%)
There are clear instructions on how to use the package.	(*n*=115)	0	9 (8%)	91 (79%)	15 (13%)
There are consistent procedures throughout the package.	(*n*=119)	0	8 (7%)	89 (75%)	22 (19%)
The videos are worthwhile and supported my learning.	(*n*=119)	2 (2%)	9 (8%)	79 (66%)	29 (24%)
The information on screen is easy to read.	(*n*=120)	2 (2%)	6 (5%)	73 (61%)	39 (33%)
The presentation is informative.	(*n*=120)	0	5 (4%)	91 (76%)	24 (20%)
The package is enjoyable to use.	(*n*=114)	2 (2%)	12 (11%)	89 (78%)	11 (10%)
The package provides useful word support and glossaries for the topic.	(*n*=113)	1 (1%)	9 (8%)	69 (61%)	34 (30%)
The package provides good advice on how to work through the material.	(*n*=113)	2 (2%)	15 (13%)	83 (74%)	13 (12%)
It helps you to learn about the topic.	(*n*=121)	1 (1%)	1 (1%)	72 (60%)	47 (39%)
It fits well with the rest of my course material.	(*n*=123)	1 (1%)	4 (3%)	65 (53%)	53 (43%)
The time spent using the package is well worth it.	(*n*=113)	3 (3%)	11 (10%)	68 (60%)	31 (27%)
It would help me to revise the subject.	(*n*=122)	1 (1%)	6 (5%)	56 (46%)	59 (48%)
I would use it again in my own time:	(*n*=120)	3 (3%)	9 (8%)	76 (63%)	32 (27%)

(*n* = total number of students responding to each scale)

Students overall attitudes towards the package were positive with over 80% of the students agreeing or strongly agreeing with all the statements. The statement;

"The package helps you to learn about the topic."

Elicited the greatest proportion of agreement or strong agreement from 119 (98%) students.

The following statement provoked the greatest proportion of disagreement or strong disagreement from 17 (15%) students.

"The movement analysis package provides good advice on how to work through the material."

Table 1.9 Key to response codes for attitudes towards the Movement Analysis Package.

Response	Code
Strongly disagree	1
Disagree	2
Agree	3
Strongly agree	4

The median values for all statements are 3 indicating on average students agreed with the statements thus reflecting positive attitudes towards the movement analysis package.

Table 1.10 Ranking of different types of delivery for Movement Analysis.

Modes of delivery	Total response	Order of ranking				
		Ranked 5th	Ranked 4th	Ranked 3rd	Ranked 2nd	Ranked 1st
web based	(n=62)	9 (15%)	17 (27%)	10 (16%)	17 (27%)	9 (15%)
CD- ROM	(n=62)	7 (11%)	17 (27%)	13 (21%)	14 (23%)	11 (18%)
Paper-based study	(n=62)	33 (53%)	11 (18%)	14 (23%)	1 (2%)	3 (5%)
Face to face teaching	(n=62)	3 (5%)	17 (27%)	14 (23%)	16 (26%)	12 (19%)
Practical class	(n=62)	10 (16%)	0	11 (18%)	14 (23%)	27 (44%)

(*n* = total number of students ranking each type of delivery)

The favoured method of delivery for movement analysis was the practical class with 27 (44%) students ranking this first. Most students ranked web-based learning second (17, 27%). The methods most commonly ranked third were paper based study and face to face teaching (14, 23%). Learning via CD-ROM and web based study (17,

27%) were the learning methods most commonly ranked fourth. 33 (53%) of students ranked paper based study as their least favoured way of learning about movement analysis.

Fig 1.1 Ranked types of delivery for Movement Analysis

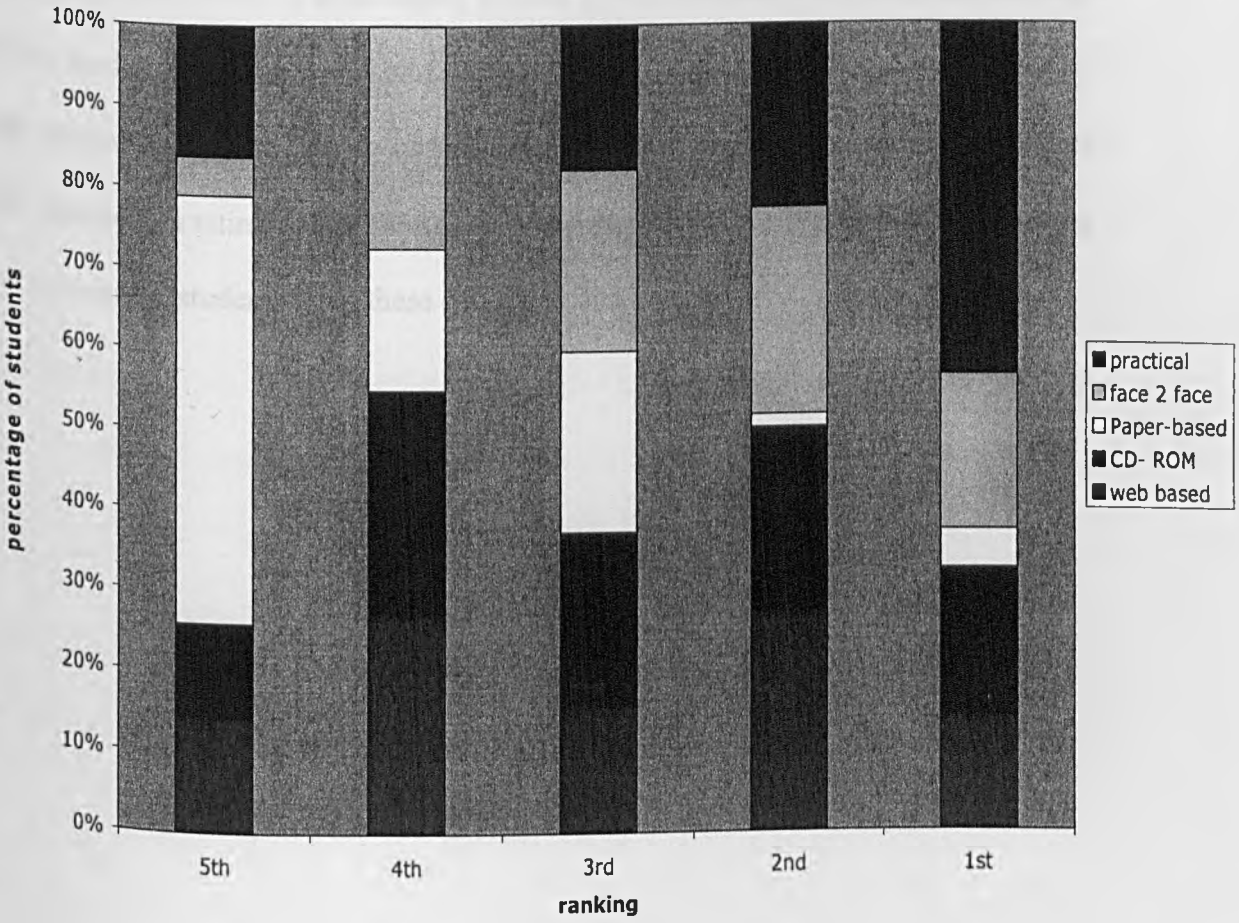


Table 1.11 Key to response codes for ranking types of delivery for movement analysis.

Rank	Code
1st	5
2nd	4
3rd	3
4th	2
5th	1

Practical classes were the most highly ranked form of delivery for movement analysis with a median value of 4 indicating an average ranking of 2nd. Paper based activity was the lowest ranked activity with a median of 1 indicating an average ranking of 5th. The median rating for web-based, CD and face to face deliveries was 3 indicating that on average students rated these deliveries 3rd.

Statistical comparison of student attitudes towards the package.

Attitudes to statements regarding the package were compared to discover whether significant differences existed between;

i. Age groups; 27 and under, 28 and over.

ii. Genders; male, female

iii. Groups; B.Sc. (Hons) Physiotherapy 2002, B.Sc. (Hons) Physiotherapy 2003, B.Sc. (Hons) Occupational Therapy 2002, M.Sc. (pre-reg.) Physiotherapy 2002, M.Sc. (pre-reg.) Physiotherapy 2003, B.Sc. (Hons) Sports and Exercise Science 2003.

The Mann-Whitney U test was used to compare age groups and genders, as these comprise two independent samples. The Kruskall-Wallis test was used to compare and test groups, as these comprise six independent samples (Argyrous 2000).

The following table shows the frequency distribution of the attitudes of students aged 27 years and under and 28 years and over towards the Movement Analysis Package.

Table 1.12 Students' attitudes towards the Movement Analysis package by age group.

Statements about the package	Total Response		Level of Agreement							
	27 and under	28 and over	Strongly disagree		Disagree		Agree		Strongly agree	
			27 and under	28 and over	27 and under	28 and over	27 and under	28 and over	27 and under	28 and over
It is clear what options are open to you at each stage.	96	14	0	1 (7%)	4 (4%)	0	77 (80%)	11 (79%)	15 (16%)	2 (14%)
It is easy to navigate to where you want to go.	100	14	1 (1%)	0	10 (10%)	3 (21%)	71 (71%)	9 (64%)	18 (18%)	2 (14%)
There are clear instructions on how to use the package.	100	14	0	0	8 (8%)	1 (7%)	78 (78%)	12 (86%)	14 (14%)	1 (7%)
There are consistent procedures throughout the package.	104	14	0	0	7 (7%)	1 (7%)	77 (74%)	11 (79%)	20 (19%)	2 (14%)
The videos are worthwhile and supported my learning.	104	14	0	2 (14%)	7 (7%)	2 (14%)	72 (69%)	6 (43%)	25 (24%)	4 (29%)
The information on screen is easy to read.	105	14	0	2 (14%)	4 (4%)	2 (14%)	68 (65%)	4 (29%)	33 (31%)	6 (43%)
The presentation is informative.	105	14	0	0	3 (3%)	2 (14%)	81 (77%)	9 (64%)	21 (20%)	3 (21%)
The package is enjoyable to use.	99	14	1 (1%)	1 (7%)	8 (8%)	4 (29%)	81 (82%)	7 (50%)	9 (9%)	2 (14%)

Table 1.13 Students' attitudes towards the Movement Analysis package by age group.

Statements about the package	Total Response		Level of Agreement							
	27 and under	28 and over	Strongly disagree		Disagree		Agree		Strongly agree	
			27 and under	28 and over	27 and under	28 and over	27 and under	28 and over	27 and under	28 and over
The package provides useful word support and glossaries for the topic.	98	14	0	1 (7%)	7 (7%)	2 (14%)	60 (61%)	8 (57%)	31 (32%)	3 (21%)
The package provides good advice on how to work through the material.	98	14	0	2 (14%)	14 (14%)	1(7%)	71 (72%)	11(79%)	13(13%)	0
It helps you to learn about the topic.	106	14	0	1 (7%)	1 (1%)	0	64 (60%)	8 (57%)	41 (39%)	5 (36%)
It fits well with the rest of my course material.	108	14	0	1 (7%)	3 (3%)	1 (7%)	56 (52%)	9 (64%)	49 (45%)	3 (21%)
The time spent using the package is well worth it.	99	13	1 (1%)	2 (15%)	8 (8%)	2 (15%)	63 (63%)	5 (39%)	27 (27%)	4 (31%)
It would help me to revise the subject.	107	14	0	1 (7%)	3 (3%)	2 (14%)	52 (49%)	4 (29%)	52 (49%)	7 (50%)
I would use it again in my own time.	105	14	1 (1%)	2 (14%)	7 (7%)	2 (14%)	69 (66%)	6 (43%)	28 (27%)	4 (29%)

Age group Comparison

Most students from both age groups agreed with the positive statements about the packages there were few observable differences between the age groups.

The statement:

"It would help me to revise the subject."

Elicited the highest proportion of strong agreement in both age groups of students (7, 50% aged 28 and over and 52, 49% aged 27 and under).

12 (86%) of students aged 28 years and over agreed that:

"There are clear instructions on how to use the package."

81 (82%) of students aged 27 years and under agreed that:

"The package was enjoyable to use."

4 (29%) of students aged 28 and over disagreed that:

"The package was enjoyable to use."

14 (14%) of students aged 27 and under disagreed that:

"The package provides good advice on how to work through the material."

Very few students strongly disagreed with the positive statements about the package.

2 (15%) students aged 28 and over strongly disagreed that:

"The time spent using the package was well worth it."

One student aged 27 and under strongly disagreed with the following statements:

"It is easy to navigate where you want to go."

"The package was enjoyable to use."

"The time spent using the package was well worth it."

" I would use it again in my own time."

There was a significant difference (p=0.04) between age groups regarding the statement;

- *"The package fits well with the rest of the course material."*

A high proportion of students aged 27 and under (49, 45%) strongly agreed with this statement compared with those aged 28 and over (3, 21%).

There were no other significant findings for comparison between ages.

Table 1.14 Students' attitudes towards the Movement Analysis package by gender.

Statements about the package	Total Response		Level of Agreement							
	Male	Female	Strongly disagree		Disagree		Agree		Strongly agree	
			Male	Female	Male	Female	Male	Female	Male	Female
It is clear what options are open to you at each stage.	22	89	1(5%)	0	0	4 (5%)	19 (86%)	70 (79%)	2 (9%)	15 (17%)
It is easy to navigate to where you want to go.	25	90	0	1 (1%)	4 (16%)	9 (10%)	18 (72%)	63 (70%)	3 (12%)	17 (19%)
There are clear instructions on how to use the package.	24	91	0	0	2 (8%)	7 (8%)	19 (79%)	72 (79%)	3 (13%)	12 (13%)
There are consistent procedures throughout the package.	24	95	0	0	2(8%)	6 (6%)	21 (88%)	68 (72%)	1 (4%)	21 (22%)
The videos are worthwhile and supported my learning.	24	95	0	2 (2%)	2 (8%)	7 (7%)	16 (67%)	63 (66%)	6 (25%)	23 (24%)
The information on screen is easy to read.	23	97	0	2 (2%)	2 (9%)	4 (4%)	16 (70%)	57 (59%)	5 (22%)	34 (35%)
The presentation is informative.	24	96	0	0	2 (8%)	3 (3%)	20 (83%)	71 (74%)	2 (8%)	22 (23%)
The package is enjoyable to use.	24	90	1(4%)	1 (1%)	8 (33%)	4 (4%)	11 (46%)	78 (87%)	4 (17%)	7 (8%)

Table 1.15 Students' attitudes towards the Movement Analysis package by gender.

Statements about the package	Total Response		Level of Agreement							
	Male	Female	Strongly disagree		Disagree		Agree		Strongly agree	
			Male	Female	Male	Female	Male	Female	Male	Female
The package provides useful word support and glossaries for the topic.	24	89	0	1 (1%)	4 (17%)	5 (6%)	15 (63%)	54 (61%)	5 (21%)	29 (33%)
The package provides good advice on how to work through the material.	24	89	1 (4%)	1 (1%)	4 (17%)	11 (12%)	17 (71%)	66 (74%)	2 (8%)	11 (12%)
It helps you to learn about the topic.	24	97	0	1 (1%)	1 (4%)	0	17 (71%)	55 (57%)	6 (25%)	41 (42%)
It fits well with the rest of my course material.	25	98	1 (4%)	0	2 (8%)	2 (2%)	15 (60%)	50 (51%)	7 (28%)	46 (47%)
The time spent using the package is well worth it.	23	90	2 (9%)	1 (1%)	5 (22%)	6 (7%)	13 (57%)	55 (61%)	3 (13%)	28 (31%)
It would help me to revise the subject.	25	97	0	1 (1%)	4(16%)	2 (2%)	12 (48%)	44 (45%)	9 (36%)	50 (52%)
I would use it again in my own time.	25	95	2 (8%)	1 (1%)	4 (16%)	5 (5%)	14 (56%)	62 (65%)	5 (20%)	27 (28%)

Gender Group Comparison

The statement eliciting the greatest proportion of strong agreement among both male (9, 36%) and female (50, 52%) students was:

"The package would help me to revise the subject."

However, different statements about the package elicited high proportions of agreement, disagreement and strong disagreement from male and female students.

78 (87%) female students agreed that:

"The package is enjoyable to use."

21 (88%) male students agreed that:

" There were consistent procedures throughout the package."

11 (12%) female students disagreed that:

"There was good advice on working through the material."

8 (33%) male students disagreed that:

"The package is enjoyable to use."

2 (2%) female students strongly disagreed that:

"The videos are worthwhile and supported my learning."

2 (9%) male students strongly disagreed that:

" The time spent using the package is well worth it."

There was a significant difference between males and females regarding the following statements;

- *"The package is enjoyable to use." ($p=0.030$)*

Male students levels of agreement / disagreement with this statement are more wide ranging with 37% (9) disagreeing or strongly disagreeing and 63% (15) agreeing or strongly agreeing. Female students mostly agreed or strongly agreed with this statement (85, 95%) with only 5% (5) disagreeing or strongly disagreeing.

- *"The package fits well with the rest of the course material." (p=0.036)*

Though both male and female students tend to agree or strongly agree with this statement females exhibited a much higher proportion of strong agreement (46, 47%) than males (7, 28%).

- *" The time spent using the package is well worth it." (p=0.006)*

Male and female students tended to agree / strongly agree with this statement but a much higher proportion of female students agree / strongly agree (83, 92%) than male students (16, 70%).

There were no other significant findings for comparison between genders.

Table 1.16 Students' attitudes towards the Movement Analysis package by group.

Group	Level of agreement	Statements about the package				
		It is clear what options are open to you at each stage.	It is easy to navigate to where you want to go.	There are clear instructions on how to use the package.	There are consistent procedures throughout the package.	The videos are worthwhile and supported my learning.
BSc Hons PT 2002	Strongly disagree	0	0	0	0	0
	Disagree	0	0	1 (6%)	0	1 (6%)
	Agree	15 (83%)	14 (82%)	11 (65%)	13 (68%)	9 (50%)
	Strongly agree	3 (17%)	3 (18%)	5 (29%)	6 (32%)	8 (44%)
	Total	20	17	17	19	18
BSc Hons PT 2003	Strongly disagree	0	0	0	0	2 (7%)
	Disagree	1 (3%)	3 (10%)	4 (14%)	4 (14%)	2 (7%)
	Agree	26 (90%)	21 (72%)	22 (76%)	20 (69%)	20 (69%)
	Strongly agree	2 (7%)	5 (17%)	3 (10%)	5 (17%)	5 (17%)
	Total	29	29	29	29	29
BSc Hons OT 2002	Strongly disagree	0	0	0	0	0
	Disagree	2 (13%)	3 (15%)	0	2 (9%)	0
	Agree	10 (67%)	15 (75%)	17 (85%)	18 (82%)	16 (67%)
	Strongly agree	3 (20%)	2 (10%)	3 (15%)	2 (9%)	8 (33%)
	Total	15	20	20	22	24
MSc PT 2002	Strongly disagree	1 (7%)	1 (7%)	0	0	0
	Disagree	0	4 (27%)	2 (13%)	1 (7%)	2 (13%)
	Agree	10 (67%)	7 (47%)	11 (73%)	11 (73%)	10 (67%)
	Strongly agree	4 (27%)	3 (20%)	2 (13%)	3 (20%)	3 (20%)
	Total	15	15	15	15	15
MSc PT 2003	Strongly disagree	0	0	0	0	0
	Disagree	1 (5%)	2 (9%)	2 (9%)	1 (5%)	4 (19%)
	Agree	17 (77%)	15 (68%)	19 (86%)	17 (77%)	13 (62%)
	Strongly agree	4 (18%)	5 (23%)	1 (5%)	4 (18%)	4 (19%)
	Total	22	22	22	22	21
BSc Hons SES 2003	Strongly disagree	0	0	0	0	0
	Disagree	0	1 (8%)	0	0	0
	Agree	11 (92%)	9 (75%)	11 (92%)	10 (83%)	11 (92%)
	Strongly agree	1 (8%)	2 (17%)	1 (8%)	2 (17%)	1 (8%)
	Total	12	12	12	12	12

Table 1.17 Students' attitudes towards the Movement Analysis package by group.

Group	Level of agreement	Statements about the package				
		The information on screen is easy to read.	The presentation is informative.	The package is enjoyable to use.	The package provides useful word support and glossaries for the topic.	The package provides good advice on how to work through the material.
BSc Hons PT 2002	Strongly disagree	0	0	0	0	0
	Disagree	1 (5%)	0	0	0	0
	Agree	11 (55%)	11 (61%)	12 (80%)	6 (46%)	14 (82%)
	Strongly agree	8 (40%)	7 (39%)	3 (20%)	7 (54%)	3 (18%)
	Total	20	18	15	13	17
BSc Hons PT 2003	Strongly disagree	1 (3%)	0	1 (3%)	1(3%)	1 (3%)
	Disagree	2 (7%)	3 (10%)	4 (14%)	2 (7%)	6 (21%)
	Agree	19 (66%)	23 (79%)	22 (76%)	19 (66%)	20 (69%)
	Strongly agree	7 (24%)	3 (10%)	2 (7%)	7 (24%)	2 (7%)
	Total	29	29	29	29	29
BSc Hons OT 2002	Strongly disagree	0	0	0	0	0
	Disagree	1 (4%)	0	0	0	1 (6%)
	Agree	14 (61%)	20 (83%)	20 (95%)	17 (74%)	15 (83%)
	Strongly agree	8 (35%)	4 (17%)	1 (5%)	6 (26%)	2 (11%)
	Total	23	24	21	23	18
MSc PT 2002	Strongly disagree	1 (7%)	0	1 (7%)	0	1 (7%)
	Disagree	2 (14%)	2 (13%)	3 (20%)	5 (36%)	4 (26%)
	Agree	6 (43%)	10 (67%)	9 (60%)	6 (43%)	6 (40%)
	Strongly agree	5 (36%)	3 (20%)	2 (13%)	3 (21%)	4 (26%)
	Total	14	15	15	14	15
MSc PT 2003	Strongly disagree	0	0	0	0	0
	Disagree	0	0	3 (14%)	0	3 (13%)
	Agree	14 (64%)	16 (73%)	18 (82%)	15 (68%)	18 (81%)
	Strongly agree	8 (36%)	6 (27%)	1 (5%)	7 (32%)	1 (5%)
	Total	22	22	22	22	22
BSc Hons SES 2003	Strongly disagree	0	0	0	0	0
	Disagree	0	0	2 (17%)	2 (17%)	1 (8%)
	Agree	9 (75%)	11 (92%)	8 (67%)	6 (50%)	10 (83%)
	Strongly agree	3 (25%)	1 (8%)	2 (17%)	4 (33%)	1 (8%)
	Total	12	12	12	12	12

Table 1.18 Students' attitudes towards the Movement Analysis package by group.

Group	Level of agreement	Statements about the package				
		It helps you to learn about the topic.	It fits well with the rest of my course material.	The time spent using the package is well worth it.	It would help me to revise the subject.	I would use it again in my own time.
BSc Hons PT 2002	Strongly disagree	0	0	0	0	0
	Disagree	0	0	0	0	0
	Agree	11 (55%)	9 (45%)	11 (61%)	9 (45%)	10 (50%)
	Strongly agree	9 (45%)	11 (55%)	7 (39%)	11 (55%)	10 (50%)
	Total	20	20	18	20	20
BSc Hons PT 2003	Strongly disagree	1 (3%)	0	1 (4%)	1 (3%)	1 (3%)
	Disagree	0	1 (3%)	4 (14%)	2 (7%)	4 (14%)
	Agree	18 (62%)	14 (48%)	13 (46%)	12 (41%)	18 (62%)
	Strongly agree	10 (35%)	14 (48%)	10 (36%)	14 (48%)	6 (21%)
	Total	29	29	28	29	29
BSc Hons OT 2002	Strongly disagree	0	0	0	0	0
	Disagree	0	0	1 (5%)	1 (4%)	1 (5%)
	Agree	15 (63%)	17 (68%)	13 (62%)	12 (50%)	16 (73%)
	Strongly agree	9 (38%)	8 (32%)	7 (33%)	11 (46%)	5 (23%)
	Total	24	25	21	24	22
MSc PT 2002	Strongly disagree	0	1 (7%)	2 (13%)	0	2 (13%)
	Disagree	1 (7%)	1 (7%)	2 (13%)	3 (20%)	0
	Agree	6 (43%)	3 (20%)	6 (40%)	4 (27%)	9 (60%)
	Strongly agree	7 (50%)	10 (67%)	5 (33%)	8 (53%)	4 (27%)
	Total	14	15	15	15	15
MSc PT 2003	Strongly disagree	0	0	0	0	0
	Disagree	0	2 (9%)	2 (10%)	0	3 (14%)
	Agree	16 (73%)	13 (59%)	18 (86%)	12 (55%)	14 (64%)
	Strongly agree	6 (27%)	7 (32%)	1 (5%)	10 (46%)	5 (23%)
	Total	22	22	21	22	22
BSc Hons SES 2003	Strongly disagree	0	0	0	0	0
	Disagree	0	0	2 (20%)	0	1 (8%)
	Agree	6 (50%)	9 (75%)	7 (70%)	7 (58%)	9 (75%)
	Strongly agree	6 (50%)	3 (25%)	1 (10%)	5 (42%)	2 (17%)
	Total	12	12	10	12	12

Course Group Comparison

Students from all groups mostly agreed with the positive statements about the packages there were few observable differences between the groups. Statements eliciting high proportions of agreement / disagreement across groups were as follows

The statement:

"It would help me to revise the subject."

Elicited a high proportion of strong agreement from BSc (Hons) Physiotherapy 2002 (11, 55%), BSc (Hons) Physiotherapy 2003 (14, 48%), BSc (Hons) Occupational therapy 2002 (11, 46%) and MSc (pre-registration) Physiotherapy 2003 (10,46%).

The statement:

"It fits well with the rest of my course material."

Elicited a high proportion of strong agreement in BSc (Hons) Physiotherapy 2002 (11, 55%), BSc (Hons) Physiotherapy 2003 (14, 48%), and MSc (pre-registration) Physiotherapy 2002 (10, 67%).

BSc (Hons) Physiotherapy 2002 (15, 83%) and BSc (Hons) Physiotherapy 2003 (26, 90%) students agreed that:

"It is clear what options are open to you at each stage."

MSc (pre-registration) Physiotherapy 2002 (11, 73%) and BSc (Hons) Sports and Exercise Science (11,92%) students agreed that:

"There are clear instructions on how to use the package."

"There are consistent procedures throughout the package."

MSc (pre-registration) Physiotherapy 2003 students (4, 19%) and BSc (Hons) Physiotherapy 2002 (1, 6%) disagreed that:

"The videos are worthwhile and supported my learning."

MSc (pre-registration) Physiotherapy 2002 (2,13%) and BSc (Hons) Physiotherapy 2003 (1, 4%) strongly disagreed that:

"The time spent using the package was well worth it."

The statements did not elicit any strong disagreement from the other four groups of students.

Statistical testing found that there were no significant differences between groups regarding levels of agreement / disagreement with statements about the package.

Open Response Questions

Students were asked the following open response questions;

1. How, if at all, do you think the movement analysis package has affected your general knowledge of anatomy?

2. How, if at all, do you think the movement analysis package has affected your understanding of anatomy?

3. How do you think you might apply what you have learned in the future?

4. Did you like using the Movement Analysis package? Please give reasons for your answer.

5. Can you suggest any improvements to the movement analysis package?

These responses to the first 3 questions were categorised into positive, equivocal and negative responses and then further analysed into common themes. Reasons for liking and disliking and suggested improvements are summarised in relation to themes. The results of the analysis were as follows;

Table 1.19 Movement Analysis package open responses (*n*=297)

Question	Positive responses	Equivocal responses	Negative responses
General Knowledge	96 (32%)	22 (7%)	6 (2%)
Understanding	70 (24%)	17 (6%)	7 (2%)
Application	74 (25%)	2 (1%)	3 (1%)
Total	240 (81%)	41 (14%)	16 (5%)

(*n*= number of comments per package rather than number of students as each student could make as many comments as they wished. Percentages have been rounded up to the nearest whole number.)

There were 240 (81%) positive comments made by students who evaluated the movement analysis package. Most of the positive comments 96 (32%) in the movement analysis evaluation were from students evaluating whether and how the package had affected their general knowledge of anatomy.

"Its very helpful to see the movement over and over and be asked questions without pressure from a lecturer."

(BSc Hons Physiotherapy 2002)

There were 41 (14%) equivocal comments made by students who evaluated the movement analysis package. Students evaluating whether and how the package had affected their general knowledge of anatomy made most equivocal comments (22, 7%) in the movement analysis evaluation.

" If given more time would help improve anatomy knowledge."

(BSc Hons Physiotherapy 2002)

There were 16 (5%) negative comments made by students who evaluated the movement analysis package. Students evaluating whether and how the package had affected their understanding of anatomy made most negative comments (7, 2%) in the movement analysis evaluation.

"Not at all due to insufficient feedback on incorrectly answered questions or in some cases the right answers being marked wrong. Also in the wording of some of the questions I was not clear what was being asked i.e. what point was being referred to."

(BSc Hons Physiotherapy 2003)

Positive comments related to the following themes;

- General comments e.g.

"My general knowledge of anatomy has improved quiet a bit since I started using the package."

(BSc Hons Sports and Exercise Science 2003)

- Reinforcement / revision of knowledge e.g.

"It has helped me to revise my anatomy and add a functional understanding to my knowledge."

(MSc pre-registration Physiotherapy 2002)

- Understanding and using terminology e.g.

"Easy to read glossary will aid my understanding of anatomy and the technical anatomical terms."

(BSc Hons Physiotherapy 2002)

- Relating knowledge e.g.

"The package has helped to relate specific muscle work to the correct areas and also how different muscles relate to each other in producing movement."

(BSc Hons Physiotherapy 2003)

- Self-assessment and feedback e.g.

"Its helpful to be able to have a space where you can practise analysing movement and correct yourself when you are getting something wrong."

(BSc Hons Physiotherapy 2003)

- The video clips

"Increased my general knowledge of anatomy especially seeing motion videos along with actions carried out by various muscle groups make it easier to understand and visualise."

(MSc pre-registration Physiotherapy 2003)

- Clarification of topics e.g.

"Clarification of girdle and shoulder."

(BSc Hons Physiotherapy 2002)

- An alternative method of study e.g.

"Provides a different, interesting approach to learning."

(BSc Hons Occupational Therapy 2002)

- Relevance to clinical / work-based activities

"The information gained was definitely applicable for future use, as it helps to learn where different muscles are and what they do, which is useful for assessing which muscles are injured in a patient."

(MSc pre-registration Physiotherapy 2002)

- Related to summative assessment;

"It is useful for the movement analysis in the OSPE." (OSPE; Objective Structured Practical Examination)

(BSc Hons Physiotherapy 2003)

The positive comments made by students for each question are summarised in relation to these themes in the following table.

Table 1.20 Showing positive comment themes per question.

Comment Theme	General knowledge (*n*=124)	Understanding (*n*=94)	Application (*n*=79)	Total Per Theme (*n*=297)
General	9 (7%)	9 (10%)	4 (5%)	22 (7%)
Reinforces / revises knowledge	20 (16%)	11 (12%)	3 (4%)	34 (11%)
Understanding / Using terminology	9 (7%)	4 (4%)	0	13 (4%)
Relating Knowledge	19 (15%)	23 (24%)	22 (28%)	64 (21%)
Self assessment / feedback	7 (6%)	1 (1%)	2 (3%)	10 (3%)
Video clips	14 (11%)	16 (17%)	7 (9%)	37 (12%)
Clarification	5 (4%)	1 (1%)	0	6 (2%)
Alternative method of study	1 (1%)	1 (1%)	0	2 (1%)
Relevance to clinical / work-based activities	12 (10%)	4 (4%)	32 (41%)	48 (16%)
Related to summative assessment	0	0	4 (5%)	4 (1%)
Total comments per question	96 (77%)	70 (74%)	74 (94%)	240 (81%)

(*n*= total number of open responses to the question for the movement analysis package)

The most common theme referred to the package relating knowledge (64, 21%). The least common themes being an alternative method of study (2, 1%). The greatest proportion of positive comments (94%) were made by students regarding how they may apply what they had learned from the package.

Equivocal comments related to the following themes;

- General comments.

" It has helped to some extent."

(BSc Hons Physiotherapy 2003)

- Lack of use.

"I didn't get the chance to access it while I was studying, this was due to timetable on the MSc. However it was informative and would help should I have had the time."

(MSc pre-registration Physiotherapy 2002)

- The need to use other learning activities to supplement the package as it is not a stand-alone package.

"Base knowledge needs to be sound before using package so traditional methods must be employed first."

(BSc Hons Physiotherapy 2003)

- Preference for another method of study.

"Some help, prefer good diagrams and pictures in a book, found working with the package quite frustrating. "

(BSc Hons Physiotherapy 2003)

- Technical problems.

" It was just unfortunate that the computers are slowish but it is still a worthwhile package and I will be making use of it!"

(BSc Hons Physiotherapy 2002)

- Video clips.

" The videos assist me but can't beat seeing the muscles in action for real."

(BSc Hons Physiotherapy 2003)

- Confusion about questions / feedback.

"Some questions are confusing, but after discussion with classmates it makes sense!"

(MSc pre-registration Physiotherapy 2002)

The equivocal comments made by students for each question are summarised in relation to these themes in the following table.

Table 1.21 Showing equivocal comment themes per question.

Comment Theme	General knowledge (*n*=124)	Understanding (*n*=94)	Application (*n*=79)	Total (*n*=297)
General	6 (5%)	6 (6%)	2 (3%)	14 (5%)
Lack of use	11 (9%)	2 (2%)	0	13 (4%)
Not stand alone package	4 (3%)	4 (4%)	0	8 (3%)
Prefer book / other method of study	1 (1%)	0	0	1 (0%)
Technical problems	0	1 (1%)	0	1 (0%)
Videos	0	2 (2%)	0	2 (1%)
Confusion about questions / feedback	0	2 (2%)	0	2 (1%)
Total Comments per statement	22 (18%)	17 (18%)	2 (3%)	41 (14%)

(*n*= total number of open responses to the question for the movement analysis package)

Students made 41(14%) equivocal open comments about the movement analysis package. The most common theme related to general comments (14, 5%). The least common themes being preference for another mode of study and technical problems (1, 0%). The effect of the package, or not, on general knowledge and understanding elicited the greatest proportion (18%) of equivocal comments.

Negative comments related to the following themes;

- General comments.

"Not very helpful in this area"

(BSc Hons Sports and Exercise Science 2003)

- The need to use other learning activities to supplement the package as it is not a stand-alone package.

" You have to have general knowledge beforehand, don't think it increases knowledge."

(BSc Hons Occupational Therapy 2002)

- Preference for another method of study.

"I will rely on books, unsure of aspects of working with the package."

(BSc Hons Physiotherapy 2003)

- Technical problems.

"If the video clips were not working properly then you could end up getting more confused than when you started."

(BSc Hons Physiotherapy 2003)

- Video Clips.

"The pictures were often confusing, showing one position where the movement described was something completely different."

(MSc pre-registration Physiotherapy 2002)

- Confusion about questions / feedback

"Insufficient feedback on incorrectly answered questions or in some cases the right answers being marked wrong. Also in the wording of some of the questions I was not clear what was being asked i.e. what point was being referred to."

(BSc Hons Physiotherapy 2003)

The negative comments made by students for each question are summarised in relation to these themes in the following table.

Table 1.22 Negative comment themes per question.

Comment Theme	General knowledge (*n*=124)	Understanding (*n*=94)	Application (*n*=79)	Total (*n*=297)
General	3 (2%)	5 (5%)	2 (3%)	10 (4%)
Not stand alone package	1(1%)	0	0	1 (0%)
Prefer book / other method of study	1 (1%)	0	1 (1%)	2 (1%)
Technical problems	1 (1%)	0	0	1 (0%)
Videos	0	1 (1%)	0	1 (0%)
Confusion about questions / feedback	0	1 (1%)	0	1 (0%)
Total Comments per statement	6 (5%)	7 (7%)	3 (4%)	16 (5%)

Students made 16 (5%) negative open comments about the movement analysis package. The most common theme related to general comments (10, 3%). Only 1 or 2 negative comments were made which related to other themes. The effect, or not, of the package on understanding elicited the greatest proportion (7%) of negative comments.

Students were asked whether they liked the movement Analysis Package or not and whether they could suggest any improvements. The results of these questions are summarised as follows;

Table 1.23 Frequency of students' responses regarding liking and suggesting improvements to the Movement Analysis package.

Questions	Total response	Yes	No
Did you like using the package?	(*n*=118)	106 (90%)	12 (10%)
Can you suggest any improvements?	(*n*=115)	62 (54%)	53 (46%)

Most students (106, 90%) liked using the movement analysis package but over half though there should be improvements (62, 54%).

Reasons for liking or not liking the package are summarised in the following tables in relation to their themes;

Table 1. 24 Reasons for liking the Movement Analysis package.

Reasons to like	Frequency (*n*=129)
General	21 (16%)
Reinforces / revises knowledge	12 (9%)
Understanding / Using terminology	4 (3%)
Relating Knowledge	15 (12%)
Self assessment / feedback	17 (13%)
Video clips	18 (14%)
Clarification	1 (1%)
Alternative method of study	10 (8%)
Relevance to clinical / work-based activities	2 (2%)
Related to summative assessment	3 (2%)
Ease of Use/ Access	18 (14%)
Total	121 (94%)

(*n* = total number of responses given for liking or not liking the package)

Students gave a total of 121(94%) reasons for liking the movement analysis package. The most common reasons given for liking the movement analysis package were general, 14% students also valued ease of use and access and the video clips. Example reasons for liking the package are given below.

"Helped bring together what had been learned from the anatomy workbooks and Palastanga."

(Anatomy and Human Movement Palastanga N. Field D. and Soames R.)

(MSc pre-registration Physiotherapy 2003)

"It was good finding out answers at the same time as doing the question so you could learn from it."

(BSc Hons Occupational Therapy 2002)

"Liked using it because you could keep rewinding or playing the video till you see/understand what was going on."

(MSc pre-registration Physiotherapy 2003)

Reasons for not liking the movement analysis package are summarised below in relation to their themes;

Table 1. 25 Reasons for not liking the Movement Analysis package

Reasons for not liking	Frequency (*n*=129)
Lack of use	1 (1%)
Not stand alone package	1 (1%)
Technical problems	4 (3%)
Videos	1 (1%)
Confusion about questions / feedback	1 (1%)
Total	8 (6%)

(*n* = total number of responses given for liking or not liking the package)

Students gave a total of 8 (6%) reasons for not liking the movement analysis package. The most common reason given for not liking the package related to technical problems 4(3%) Example reasons for not liking the package are given below.

"Found the questions did not relate well to the graphics."

(BSc Hons Occupational Therapy 2002)

"Couldn't get into it from home."

(MSc pre-registration Physiotherapy 2002)

"It took too long to get into it at Woolmanhill. Computer lab is frequently too busy to be able to study effectively."

(MSc pre-registration Physiotherapy 2002)

Students were asked to suggest any improvements they felt could be made to the movement analysis package. These are summarised below in relation to their common themes.

Table 1.26 Suggested improvements to the Movement Analysis package.

Improvement Theme	Frequency
Marking/feedback	13 (28%)
Length	1 (2%)
Increased / Improved Access	9 (20%)
Videos	4 (9%)
Extend Package	8 (17%)
Layout	9 (20%)
Support	1 (2%)
Wording	1 (2%)
Total	46 (100%)

Students suggested a total of 46 improvements to the movement analysis package. Most of the suggested improvements were related to marking and feedback (13, 28%).

" Marking of questions more understandable."

(BSc Hons Occupational Therapy 2002)

Increased or improved access and layout were the next most common themes for improvement (9, 20%).

"To have it on CD as well as on the computers in college would be useful also especially for revision around exam time and over the holidays. I found it difficult to gain access to it at home via the net so a CD would have been handy."

(BSc Hons Physiotherapy 2003)

8 (17%) of suggested improvements also related to extending the package.

" Pictures or diagrams about location of muscles would be greatly beneficial for me. "

(MSc pre-registration Physiotherapy 2003)

Section 2 Manual therapy package

Demographic information

The numbers of students in each group, their ages and genders are presented in the following tables.

Two groups of students used and evaluated the manual therapy package. These groups comprised the following numbers of students:

Table 2.1 Groups of students evaluating the Manual Therapy package.

Group	Number of students in year	Students completing evaluation
1. BSc Hons PT 2003	46	20
4. MSc PT 2004	23	19
Total	69	39

The groups of students evaluating the package were almost even in number. The age and gender distribution of each group was as follows:

Table 2.2 Gender distribution of students per group.

		Group		Total
		BSc Hons PT 2003	MSc PT 2004	
Gender	Male	5	7	12
	Female	15	12	27
Total		20	19	39

There were 27 female students and 12 male students who evaluated the manual therapy package. Both groups had a greater ratio of female to male students.

Table 2.3 Age distribution of students per group.

		Group		Total
		BSc Hons PT 2003	MSc PT 2004	
Age	27 and under	20	15	35
	28 and over	0	3	3
Total		20	18	38
Percentage of mature students per group		0%	17%	8%

In both groups there was a higher number of students age 27 and under, only 17% of students overall being 28 years or over. No students who evaluated the manual therapy package in the BSc (Hons) Physiotherapy 2003-year group were age 28 years or over.

Likert scale responses and ranking of delivery modes.

This section reports student attitudes towards computers, confidence in various computer-based activities, and attitudes towards different features of the manual therapy package, which were elicited using Likert scales. Students were also asked to rank their preferred modes of delivery for learning about manual therapy.

Attitudes towards computers were as follows. Agreement with the following statements was considered to indicate a positive attitude towards computers.

- Anyone can use a computer.
- Computer Literacy will make me more employable

Agreement with the following statements was considered to indicate a negative attitude towards computers.

- I find a computer difficult to use.
- Computers isolate you from other people.

- I am afraid of looking silly if I make a mistake while using the computer.

Attitudes towards computers were elicited from the student groups and these were as follows:

Table 2.4 Attitudes to computers for students evaluating the Manual Therapy package.

Statements about Computers	Total response	Level of Agreement			
		Strongly disagree	Disagree	Agree	Strongly agree
Anyone can use a computer.	(*n*=39)	0	1 (3%)	23 (59%)	15 (39%)
I find a computer difficult to use.	(*n*=39)	8 (21%)	27 (69%)	3 (8%)	1 (3%)
Computers isolate you from other people.	(*n*=39)	4 (10%)	16 (41%)	18 (46%)	1 (3%)
Computer literacy will make me more employable.	(*n*=39)	0	1 (3%)	19 (49%)	19 (49%)
I am afraid of looking silly if making a mistake while using the computer.	(*n*=39)	5 (13%)	31 (80%)	3 (8%)	0

(*n* = total number of students responding to each scale)

Students exhibited mainly positive attitudes towards computers with 38 (97%) either strongly agreeing or agreeing that computer literacy will make them more employable and 38 (97%) either strongly agreeing or agreeing that anyone can use a computer. The majority also disagreed or strongly disagreed that they found computers difficult to use (35, 90%) or that they were afraid of looking silly making a mistake while using the computer (36, 92%). However 49% of students did agree or strongly agree that computers isolate you from other people.

Table 2.5 Key to response codes for attitudes towards computers.

Response	Code	
	Positive statements	Negative statements
Strongly Disagree	1	4
Disagree	2	3
Agree	3	2
Strongly Agree	4	1

For all statements the median value was 3 indicating that on average students agreed with the positive statements and disagreed with the negative statements about computers.

Students' responses to their level of confidence with different computer based activities were as follows;

Table 2.6 Confidence with different computer-based activities.

Computer based activity	Total response	Level of confidence				
		No confidence	Little confidence	Some confidence	confident	Very confident
web based	(*n*=37)	0	1 (3%)	2 (5%)	26 (70%)	8 (21%)
Navigating materials on-line	(*n*=37)	0	1 (3%)	6 (16%)	24 (65%)	6 (16%)
reading on-line	(*n*=37)	0	1 (3%)	3 (8%)	29 (78%)	4 (11%)
Using multimedia	(*n*=37)	0	1 (3%)	7 (19%)	25 (68%)	4 (11%)
Independent study	(*n*=37)	0	1 (3%)	1 (3%)	26 (70%)	9 (24%)
self study	(*n*=36)	1 (3%)	1 (3%)	5 (14%)	21 (58%)	8 (22%)

(*n* = total number of students responding to each scale)

Students identified that were mainly confident or very confident in all the computer based activities. Only 2 (6%) students who evaluated the manual therapy package had no or little confidence in using computers for self study and 7 (19%) students who evaluated the manual therapy package only had some confidence in using multimedia.

Table 2.7 Key to response codes for confidence in computer-based activities.

Response	Code
No Confidence	1
Little confidence	2
Some confidence	3
Confident	4
Very confident	5

The median values for all statements were 4. This indicated that students tended to be confident with all these activities.

Students' attitudes towards statements about the manual therapy package are as follows.

Table 2.8 Students' attitudes towards the manual therapy package.

Statements about the package	Total response	Level of Agreement			
		Strongly disagree	Disagree	Agree	Strongly agree
It is clear what options are open to you at each stage.	(*n*=39)	0	4 (10%)	30 (77%)	5 (13%)
It is easy to navigate to where you want to go.	(*n*=38)	1 (3%)	0	32 (84%)	5 (13%)
There are clear instructions on how to use the package.	(*n*=39)	0	4 (10%)	31 (80%)	4 (10%)
There are consistent procedures throughout the package.	(*n*=39)	1 (3%)	6 (15%)	25 (64%)	7 (18%)
The videos are worthwhile and supported my learning.	(*n*=39)	1 (3%)	0	22 (56%)	16 (41%)
The information on screen is easy to read.	(*n*=39)	0	0	27 (69%)	12 (31%)
The presentation is informative.	(*n*=38)	0	1 (3%)	27 (71%)	10 (26%)
The package is enjoyable to use.	(*n*=39)	0	9 (23%)	26 (67%)	4 (10%)
It helps you to learn about the topic.	(*n*=39)	0	3 (8%)	27 (69%)	9 (23%)
It fits well with the rest of my course material.	(*n*=39)	0	2 (5%)	27 (69%)	10 (26%)
The time spent using the package is well worth it.	(*n*=39)	0	6 (15%)	29 (74%)	4 (10%)
It would help me to revise the subject	(*n*=39)	0	3 (8%)	25 (64%)	11 (28%)
I feel more confident towards computer assisted study materials.	(*n*=38)	0	6 (16%)	28 (74%)	4 (11%)
It has allowed me access to a useful resource.	(*n*=38)	0	3 (8%)	24 (63%)	11 (29%)

(*n* = total number of students responding to each scale)

Students overall attitudes towards the package were positive with at least 77% of the students agreeing or strongly agreeing with all the statements. The statement;

"The information on screen is easy to read."

elicited the greatest proportion of agreement or strong agreement from 39 (100%) students.

The following statement elicited the greatest proportion of disagreement or strong disagreement from 9 (23%) students.

"The manual therapy package is enjoyable to use."

Table 2.9 Key to response codes for attitudes towards the Manual Therapy Package.

Response	Code
Strongly disagree	1
Disagree	2
Agree	3
Strongly agree	4

The median values for all statements were 3 indicating an average agreement with the statements and reflecting positive attitudes towards the manual therapy package.

Students were asked to rank their preferred methods of delivery for learning about Manual Therapy the results are as follows:

Table 2.10 Ranking of different types of delivery for manual therapy.

Types of Computer based Activity	Total response	Order of ranking				
		Ranked 5th	Ranked 4th	Ranked 3rd	Ranked 2nd	Ranked 1st
web based	(n=37)	4 (11%)	8 (22%)	11 (30%)	8 (22%)	6 (16%)
CD- ROM	(n=37)	3 (8%)	11 (30%)	9 (24%)	11 (30%)	3 (8%)
Paper-based study	(n=37)	23 (62%)	8 (22%)	4 (11%)	2 (5%)	0
Face to face teaching	(n=37)	7 (19%)	10 (27%)	6 (16%)	12 (32%)	2 (5%)
Practical class	(n=37)	0	0	7 (19%)	4 (11%)	26 (70%)

(*n* = total number of students ranking each delivery method)

The favoured method of delivery for manual therapy was the practical class with 26 (70%) students ranking this first. Most students ranked face to face teaching second (12, 32%). The method most commonly ranked third was web based learning (11,

30%). Learning via CD-ROM (11.30%) was the learning method most commonly ranked fourth. 23 (62%) of students ranked paper based study as their least favoured way of learning about manual therapy.

Fig.2.1

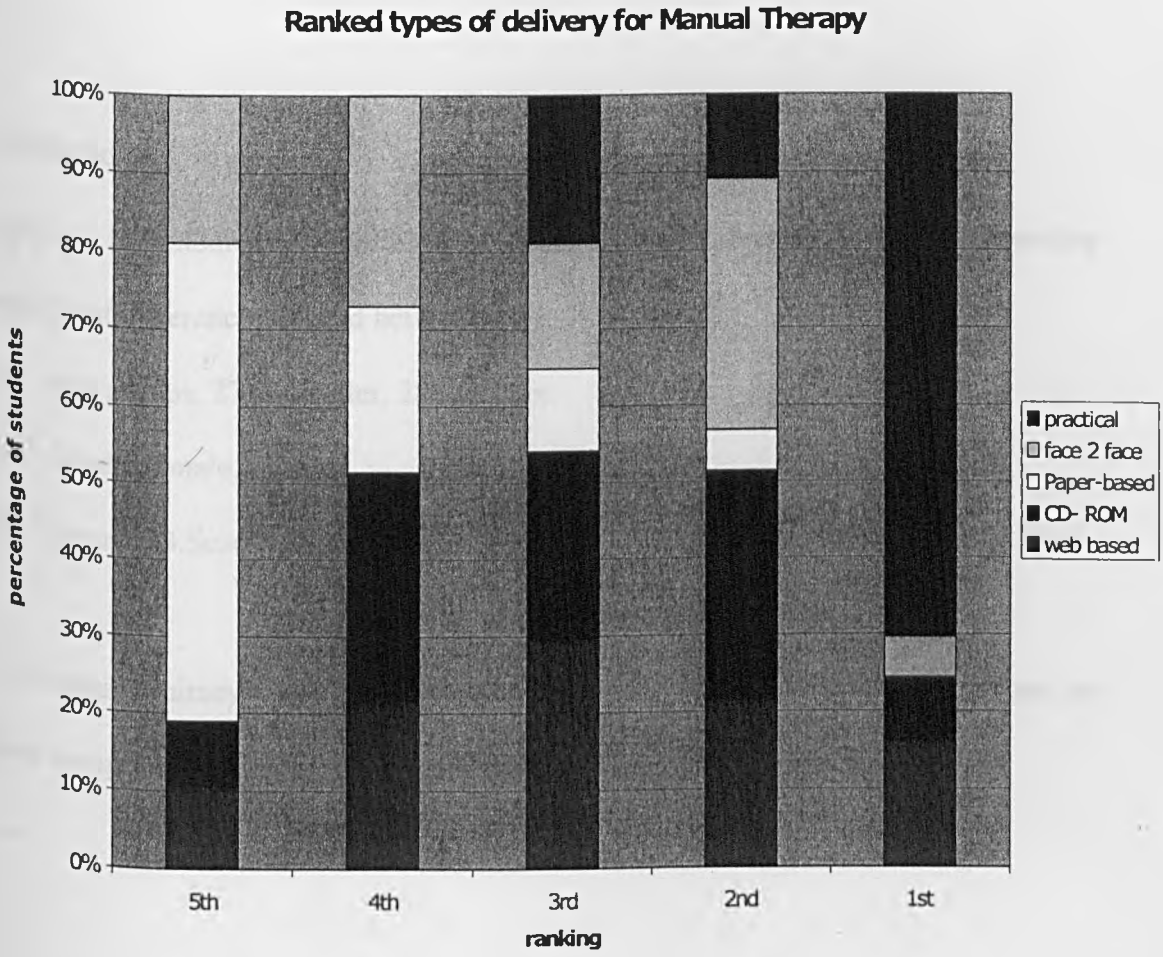


Table 2.11 Key to response codes for ranking types of delivery for manual therapy.

Rank	Code
1st	5
2nd	4
3rd	3
4th	2
5th	1

Practical classes were the most highly ranked form of delivery for manual therapy with a median value of 5 indicating an average ranking of 1st. Paper based activity was the lowest ranked activity with a median of 1 indicating an average ranking of 5th. The median rating for web-based, CD and face to face deliveries was 3 indicating that on average students rated these deliveries 3rd.

Statistical comparison of student attitudes towards the package.

Attitudes to statements regarding the package were compared to discover whether significant differences existed between;

i. Age groups; 27 and under, 28 and over.
ii. Genders; male, female
iii. Groups; B.Sc. (Hons) Physiotherapy 2003 M.Sc. (pre-reg.) Physiotherapy 2004,

The Mann-Whitney U test was used to compare age groups, genders and groups, as these comprise two independent samples (Argyrous 2000).

Table 2.12a Students' attitudes towards the Manual Therapy package by age group.

Statements about the package	Total Response		Level of Agreement							
	27 and under	28 and over	Strongly disagree		Disagree		Agree		Strongly agree	
			27 and under	28 and over	27 and under	28 and over	27 and under	28 and over	27 and under	28 and over
It is clear what options are open to you at each stage.	35	3	0	0	4 (11%)	0	27 (77%)	2 (67%)	4 (11%)	1 (33%)
It is easy to navigate to where you want to go.	34	3	1 (3%)	0	0	0	28 (82%)	3 (100%)	5(15%)	0
There are clear instructions on how to use the package.	35	3	0	0	2 (6%)	2 (67%)	29 (83%)	1 (33%)	4 (11%)	0
There are consistent procedures throughout the package.	35	3	1 (3%)	0	4 (11%)	2 (67%)	24 (69%)	0	6 (17%)	1 (33%)
The videos are worthwhile and supported my learning.	35	3	1 (3%)	0	0	0	19 (54%)	2 (67%)	15 (43%)	1 (33%)
The information on screen is easy to read.	35	3	0	0	0	0	24 (69%)	2 (67%)	11 (31%)	1 (33%)
The presentation is informative.	34	3	0	0	1 (3%)	(%)	23 (68%)	3 (100%)	10 (29%)	0
The package is enjoyable to use.	35	3	0	0	7 (20%)	2 (67%)	24 (69%)	1 (33%)	4 (11%)	0

Table 2.12b Students' attitudes towards the Manual Therapy package by age group.

Statements about the package	*Total Response*		*Level of Agreement*							
	27 and under	28 and over	Strongly disagree		Disagree		Agree		Strongly agree	
			27 and under	28 and over	27 and under	28 and over	27 and under	28 and over	27 and under	28 and over
It helps you to learn about the topic.	35	3	0	0	3 (9%)	0	24 (69%)	2 (67%)	8 (23%)	1 (33%)
It fits well with the rest of my course material.	35	3	0	0	2 (6%)	0	23 (66%)	3 (100%)	10 (29%)	0
The time spent using the package is well worth it.	35	3	0	0	6 (17%)	0	25 (71%)	3 (100%)	4 (11%)	0
It would help me to revise the subject.	35	3	0	0	3 (9%)	0	21 (60%)	3 (100%)	11 (31%)	0
The package has increased my confidence in using computers to learn	35	2	0	0	6 (17%)	0	25 (71%)	2 (100%)	4 (11%)	0
It has allowed me access to a useful resource.	34	3	0	0	3 (9%)	0	20 (59%)	3 (100%)	11 (32%)	0

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Age group Comparison

Most students from both age groups agreed with the positive statements about the package.

1 (33%) student aged 28 and over strongly agreed with the following statements:

"It is clear what options are open to you at each stage."

"There are consistent procedures throughout the package."

"The videos are worthwhile and supported my learning."

"The information is easy to read."

"It helps you to learn about the topic."

"It would help me to revise the subject."

The statement:

"The videos are worthwhile and supported my learning."

Elicited the highest proportion of strong agreement in students aged 27 and under (37, 48%).

4 (100 %) of students aged 28 years and over agreed that:

"It is easy to navigate where you want to go."

"The presentation is informative."

"It fits well with the rest of my course material."

"The time spent using the package is well worth it."

"It has allowed me access to a useful resource."

63 (82%) of students aged 27 years and under agreed that:

"There are clear instructions on how to use the package."

2 (50%) of students aged 28 and over disagreed that:

"There are clear instructions on how to use the package."

"There are consistent procedures throughout the package."

"The package was enjoyable to use."

9 (12 %) of students aged 27 and under disagreed that:

"I feel more confident towards computer assisted study materials."

Very few students strongly disagreed with the positive statements about the package.

No students aged 28 and over strongly disagreed with any of the statements about the manual therapy package.

One student aged 27 and under strongly disagreed with the following statements:

"It is easy to navigate where you want to go."

"There are consistent procedures throughout the package."

"The videos are worthwhile and supported my learning."

There were no significant differences in attitudes towards the package for comparison between age groups.

Table 2.13a Students' attitudes towards the Manual Therapy package by gender.

Statements about the package	Total Response		Level of Agreement							
	Male	Female	Strongly disagree		Disagree		Agree		Strongly agree	
			Male	Female	Male	Female	Male	Female	Male	Female
It is clear what options are open to you at each stage.	12	27	0	0	1 (8%)	3 (11%)	11 (92%)	19 (70%)	0	5 (19%)
It is easy to navigate to where you want to go.	12	26	1 (8%)	0	0	0	10 (83%)	22 (85%)	1 (8%)	4 (15%)
There are clear instructions on how to use the package.	12	27	0	0	3 (25%)	1 (4%)	9 (75%)	22 (82%)	0	4 (15%)
There are consistent procedures throughout the package.	12	27	0	1 (4%)	2 (17%)	4 (15%)	9 (75%)	16 (59%)	1 (8%)	6 (22%)
The videos are worthwhile and supported my learning.	12	27	0	1 (4%)	0	0	8 (67%)	14 (52%)	4 (33%)	12 (44%)
The information on screen is easy to read.	12	27	0	0	0	0	9 (75%)	18 (67%)	3 (25%)	9 (33%)
The presentation is informative.	12	26	0	0	0	1 (4%)	11 (92%)	16 (62%)	1 (8%)	9 (35%)
The package is enjoyable to use.	12	27	0	0	4 (33%)	5 (19%)	7 (58%)	19 (70%)	1 (8%)	3 (11%)

Table 2.13b Students' attitudes towards the Manual Therapy package by gender.

Statements about the package	Total Response		Level of Agreement							
	Male	Female	Strongly disagree		Disagree		Agree		Strongly agree	
			Male	Female	Male	Female	Male	Female	Male	Female
It helps you to learn about the topic.	12	27	0	0	2 (17%)	1 (4%)	7 (58%)	20 (74%)	3 (25%)	6 (22%)
It fits well with the rest of my course material.	12	27	0	0	2 (17%)	0	7 (58%)	20 (74%)	3 (25%)	7 (26%)
The time spent using the package is well worth it.	12	27	0	0	3 (25%)	3 (11%)	8 (67%)	21 (79%)	1 (8%)	3 (11%)
It would help me to revise the subject.	12	27	0	0	1 (8%)	2 (7%)	8 (67%)	17 (63%)	3 (25%)	8 (30%)
I feel more confident towards computer assisted study materials	12	26	0	0	1 (8%)	5 (19%)	10 (83%)	18 (69%)	1 (8%)	3 (12%)
It has allowed me access to a useful resource.	12	26	0	0	1 (8%)	2 (8%)	6 (50%)	18 (69%)	5 (42%)	6 (23%)

Gender Group Comparison

Most students from both genders agreed with the positive statements about the package.

For both males (11, 48%) and females (27, 46%) the statement eliciting the highest proportion of strong agreement was:

"The videos are worthwhile and supported my learning."

19 (83%) male students agreed that:

"I feel more confident towards computer assisted study materials."

"The presentation is informative."

50 (86%) female students agreed that:

"It is easy to navigate where you want to go."

4 (17%) male students disagreed that:

"The package was enjoyable to use."

8 (14%) female students disagreed that:

"I feel more confident towards computer assisted study materials."

One male (4%) and one female (2%) student only, expressed strong disagreement towards the following statements:

Male; *"It is easy to navigate where you want to go."*

Female; *"There are consistent procedures throughout the package."* And *"The videos are worthwhile and supported my learning."*

There were no significant differences in attitudes towards the package for comparison between genders.

Table 2.14a Students' attitudes towards the Manual Therapy package by group.

Group	Level of agreement	Statements about the package				
		It is clear what options are open to you at each stage.	It is easy to navigate to where you want to go.	There are clear instructions on how to use the package.	There are consistent procedures throughout the package.	The videos are worthwhile and supported my learning.
MSc (pre-reg.) PT 2004	Strongly disagree	0	1 (6%)	0	1 (5%)	1 (5%)
	Disagree	4 (21%)	0	4 (21%)	5 (26%)	0
	Agree	13 (68%)	15 (83%)	15 (79%)	11 (58%)	13 (68%)
	Strongly agree	2 (11%)	2 (11%)	0	2 (11%)	5 (26%)
	Total	19	18	19	19	19
BSc Hons PT 2003	Strongly disagree	0	0	0	0	0
	Disagree	0	0	0	1 (5%)	0
	Agree	17 (85%)	17 (85%)	16 (80%)	14 (70%)	9 (45%)
	Strongly agree	3 (15%)	3 (15%)	4 (20%)	5 (25%)	11 (55%)
	Total	20	20	20	20	

Table 2.14b Students' attitudes towards the Manual Therapy package by group.

Group	Level of agreement	Statements about the package				
		The information on screen is easy to read.	The presentation is informative.	The package is enjoyable to use.	It helps you to learn about the topic.	It fits well with the rest of my course material.
MSc (pre-reg.) PT 2004	Strongly disagree	0	0	0	0	0
	Disagree	0	1 (6%)	8 (42%)	2 (11%)	2 (11%)
	Agree	14 (74%)	14 (78%)	10 (53%)	16 (84%)	14 (74%)
	Strongly agree	5 (26%)	3 (17%)	1 (5%)	1 (5%)	3 (16%)
	Total	19	18	19	19	(%)
BSc Hons PT 2003	Strongly disagree	0	0	0	0	0
	Disagree	0	0	1 (5%)	1 (5%)	0
	Agree	13 (65%)	13 (65%)	16 (80%)	11 (55%)	13 (65%)
	Strongly agree	7 (35%)	7 (35%)	3 (15%)	8 (40%)	7 (35%)
	Total	20	20	20	20	20

Table 2.14c Students' attitudes towards the Manual Therapy package by group.

Group	Level of agreement	Statements about the package			
		The time spent using the package is well worth it.	It would help me to revise the subject.	I feel more confident towards computer assisted study materials	It has allowed me access to a useful resource.
MSc (pre-reg.) PT 2004	Strongly disagree	0	0	0	0
	Disagree	5 (26%)	2 (11%)	4 (22%)	2 (11%)
	Agree	14 (74%)	13 (68%)	13 (72%)	12 (67%)
	Strongly agree	0	4 (21%)	1 (6%)	4 (22%)
	Total	19	19	18	18
BSc Hons PT 2003	Strongly disagree	0	0	0	0
	Disagree	1 (5%)	1 (5%)	2 (10%)	1 (5%)
	Agree	15 (75%)	12 (60%)	15 (75%)	12 (60%)
	Strongly agree	4 (20%)	7 (35%)	3 (15%)	7 (35%)
	Total	20	20	20	20

Course Group Comparison

Most students in both groups tended to agree with the positive statements about the Manual Therapy package.

The greatest proportion (5, 26%) of strong agreement among students in the MSc (pre-reg.) Physiotherapy intake 2004 group was regarding the statement;

"The videos are worthwhile and supported my learning."

"The information on screen is easy to read."

11 (55%) students in the BSc (Hons.) Physiotherapy 2003 intake also strongly agreed that;

"The videos are worthwhile and supported my learning."

16 (84%) students in the MSc (pre-reg.) Physiotherapy intake 2004 agreed that;

"It helps you to learn about the topic."

The greatest proportion of agreement among BSc (Hons.) Physiotherapy 2003 intake (17, 85%) was regarding;

"It is clear what options are open to you at each stage."

"It is easy to navigate where you want to go."

8 (84%) students in the MSc (pre-reg.) Physiotherapy intake 2004 disagreed that;

"The package is enjoyable to use."

The greatest proportion of disagreement among BSc (Hons.) Physiotherapy 2003 intake (2, 10%) was regarding;

"I feel more confident towards computer assisted study materials."

1 student in the MSc (pre-reg.) Physiotherapy intake 2004 group expressed strong disagreement with the statements;

"It is easy to navigate where you want to go."

"The videos are worthwhile and supported my learning."

"There are consistent procedures throughout the package."

Students in the BSc (Hons.) Physiotherapy 2003 intake did not express any strong disagreement.

Students in the BSc (Hons.) Physiotherapy 2003 intake were significantly more likely to agree with the statement;

- *The package is enjoyable to use. (p=0.28)*

Open response questions

Students were asked the following open response questions;

1. How, if at all, do you think the manual therapy package has affected your general knowledge of manual therapy?

2. How, if at all, do you think the manual therapy package has affected your understanding of manual therapy?

3. How do you think you might apply what you have learned in the future?

4. On reflection how do you think the package has affected your learning?

5. Did you like using the manual therapy package? Please give reasons for your answer.

6. Can you suggest any improvements to the movement analysis package?

These responses were categorised into positive, equivocal and negative responses and then further analysed into common themes. The results of the analysis were as follows:

Table 2.15 Manual Therapy package open responses. (*n*=139)

Question	Positive responses	Equivocal responses	Negative responses
General Knowledge	34 (24%)	3 (2%)	3 (2%)
Understanding	29 (21%)	3 (2%)	4 (3%)
Application	20 (14%)	2 (1%)	3 (2%)
Reflection on learning	28 (20%)	9 (6%)	1 (1%)
Total	111 (80%)	17 (12%)	11 (8%)

(*n*= number of comments per package rather than number of students as each student could make as many comments as they wished. Percentages have been rounded up to the nearest whole number.)

There were 111 (80%) positive comments made by students evaluating the manual therapy package and 17 (12%) equivocal comments. There were 11 (8%) negative comments made by students evaluating the manual therapy package.

Most of the positive comments (34, 24%) in the manual therapy evaluation were made by students regarding the effect, or not, of the package on their general knowledge of manual therapy.

"I enjoyed using the package as it was simple to understand it was informative and also required some thought."

(BSc Hons Physiotherapy 2003)

Most equivocal comments in the manual therapy evaluation (9, 6%) came from students reflecting on the effect of the package on their learning.

"Do not think it affected the way I learn just given me an additional form of self-learning."

(MSc pre-registration Physiotherapy 2004)

Most negative comments in the manual therapy evaluation (4, 3%) were from students regarding the effect, or not of the package on their understanding.

"Confused on certain parts with presenting correct answers and being marked negatively."

(MSc pre-registration Physiotherapy 2004)

Positive comments related to the following themes;

- General comments e.g.

"Improved my general knowledge"

(MSc pre-registration Physiotherapy 2004)

- Reinforcement / revision of knowledge e.g.

"Reinforced what I learned in the classes"

(BSc Hons Physiotherapy 2003)

- Self-assessment and feedback e.g.

"Answers you don't know the answers can be looked at"

(BSc Hons Physiotherapy 2003)

- The video clips

"Increased visual understanding of therapy"

(BSc Hons Physiotherapy 2003)

- Clarification of topics e.g.

"It was good to go over it again and clarify some of the techniques"

(MSc pre-registration Physiotherapy 2004)

- An alternative method of study e.g.

"Change from trawling through books"

(BSc Hons Physiotherapy 2003)

- Relevance to clinical / work-based activities

"Apply correct treatment for given problem,"

(MSc pre-registration Physiotherapy 2004)

The positive comments made by students for each question are summarised in relation to these themes in the following table.

Table 2.16 Showing positive comment themes per question.

Comment Theme	General knowledge (*n*=40)	Understanding (*n*=36)	Application (*n*=25)	Reflection on learning (*n*=38)	Total Per Theme (*n*=139)
General	10 (25%)	6 (17%)	1 (4%)	7 (18%)	24 (17%)
Reinforces / revises knowledge	5 (13%)	5 (14%)	3 (12%)	5 (13%)	18 (13%)
Self assessment / feedback	10 (25%)	8 (22%)	2 (8%)	7 (18%)	27 (19%)
Video clips	5 (13%)	5 (14%)	0	4 (11%)	14 (10%)
Clarification	0	4 (11%)	0	0	4 (3%)
Alternative method of study	0	1 (3%)	0	4 (11%)	5 (4%)
Relevance to clinical / work-based activities	4 (10%)	0	14 (50%)	1 (3%)	19 (14%)
Total comments per question	34 (80%)	29 (81%)	20 (80%)	28 (74%)	111 (80%)

(*n*= total number of open responses to the question for the manual therapy package)

Students made 111 (80%) positive open comments about the manual therapy package. Most positive comments for the manual therapy package (27, 19%) were related to the theme of self-assessment and feedback. The greatest proportion of positive comments (29, 81%) were made regarding the effect of the package, or not, on understanding.

Equivocal comments related to the following themes;

- General comments e.g.

" Reasonable."

(BSc Hons Physiotherapy 2003)

- Lack of use e.g.

"Did not really use the program enough for it to make a difference to my learning."

(MSc pre-registration Physiotherapy 2004)

- The need to use other learning activities to supplement the package as it is not a stand-alone package e.g.

" It helped to re-enforce what we already knew rather than teaching us anything new."

(MSc pre-registration Physiotherapy 2004)

- Preference for another method of study e.g.

" Not as good as practical but still a great tool for understanding manual therapy better."

(BSc Hons Physiotherapy 2003)

- Technical problems e.g.

"If the technical aspects were improved ie availability etc. then maybe it would prove more useful."

(MSc pre-registration Physiotherapy 2004)

- Video clips

"Has just helped me in looking at how the hands should be positioned and how the vertebral structures move on each."

(BSc Hons Physiotherapy 2003)

The equivocal comments made by students for each question are summarised in relation to these themes in the following table.

Table 2.17 Showing equivocal comment themes per question.

Comment Theme	General knowledge (*n*=40)	Understanding (*n*=36)	Application (*n*=25)	Reflection on learning (*n*=38)	Total (*n*=139)
General	2 (5%)	1 (3%)	2 (8%)	2 (5%)	7 (5%)
Lack of use	0	0	0	1 (3%)	1 (1%)
Not stand alone package	1 (3%)	0	0	2 (5%)	3 (2%)
Prefer book / other method of study	0	1 (3%)	0	1 (3%)	2 (1%)
Technical problems	0	0	0	1 (3%)	1 (1%)
Videos	0	1 (3%)	0	2 (5%)	3 (2%)
Total Comments per statement	3 (8%)	3 (8%)	2 (8%)	9 (24%)	17 (12%)

(*n*= total number of open responses to the question for the manual therapy package)

Students made 17(12%) equivocal open comments about the manual therapy package. Most equivocal / negative open comments for the manual therapy package related to the theme of general comments for each question (16, 9%). The greatest proportion of equivocal responses (9, 24%) was in relation to reflection on the learning experience.

Negative comments related to the following themes;

- General comments

"It didn't."

(MSc pre-registration Physiotherapy 2004)

- Confusion about questions / feedback

"It hasn't affected the way I learn I felt pressured to do well so I learned the answers not the understanding of the questions also the test could have been done without practising as the questions were different."

(BSc Hons Physiotherapy 2003)

The negative comments made by students for each question are summarised in relation to these themes in the following table.

Table 2.18 Showing negative comment themes per question.

Comment Theme	General knowledge (*n*=40)	Understanding (*n*=36)	Application (*n*=25)	Reflection on learning (*n*=38)	Total (*n*=139)
General	3 (8%)	2 (6%)	3 (12%)	0	8 (6%)
Confusion about questions / feedback.	0	2 (6%)	0	1 (3%)	3 (2%)
Total Comments per statement	3 (8%)	4 (11%)	3 (12%)	1 (3%)	11 (8%)

There were more general negative responses (8, 6%) than those relating to confusion about the questions or feedback (3, 2%)

Students were asked whether they liked the manual therapy package and whether they could suggest any improvements. The results of these questions are summarised as follows:

Table 2.19 Showing frequencies of students' responses regarding liking and suggesting improvements to the Manual Therapy package.

Questions	Total response	Yes	No
Did you like using the package?	(*n*=36)	27 (75%)	9(25%)
Can you suggest any improvements?	(*n*=36)	16 (44%)	20 (56%)

Most students (27, 75%) liked using the movement analysis package and less than half thought there should be improvements (16, 44%).

Reasons for liking or not liking the package are summarised in the following tables in relation to their themes:

Table 2.20 Reasons for liking the Manual Therapy package.

Comment Theme	Reasons to like (*n*=38)
General	11 (29%)
Reinforces / revises knowledge	3 (8%)
Self assessment / feedback	6 (16%)
Video clips	7 (18%)
Alternative method of study	5 (13%)
Ease of Use/ Access	4 (11%)
Total comments per question	36 (95%)

(*n* = total number of responses given for liking or not liking the package)

Students gave a total of 36(95%) reasons for liking the manual therapy package. The most common reason given for liking the manual therapy package was general reasons (11, 29%). Example reasons for liking the package are given below:

" *Fun way to learn, videos give you extra information that a paper copy of the package would not be able to do. You can monitor your progress if you repeat the questions.* "

(BSc Hons Physiotherapy 2003)

"I like being able to watch the mobs being performed and then being able to watch them again."

(BSc Hons Physiotherapy 2003)

Reasons for not liking the manual therapy package are summarised below in relation to their themes;

Table 2. 21 Reasons for not liking the Manual Therapy package.

Comment Theme	Reasons for not liking (*n*=38)
Ease of use / access	1 (3%)
Confusion about questions / feedback	1 (3%)
Total Comments per statement	2 (5%)

(*n* = total number of responses given for liking or not liking the package)

Students gave a total of 2 (5%) reasons for not liking the manual therapy package. The reasons for not liking the package are given below.

"I felt pressure to get a good mark so memorised the answers and not the questions. If the question was worded differently I wouldn't know the answer, it was added pressure, the score doesn't even go towards our final grade for second year."

(BSc Hons Physiotherapy 2003)

" It was useful for understanding and reinforcing class work but it was hard to find computers to practise it on."

(BSc Hons Physiotherapy 2003)

Students were asked to suggest any improvements they felt could be made to the movement analysis package. These are summarised below in relation to their common themes.

Students were asked to suggest improvements to the manual therapy package and these are summarised below in relation to their common themes.

Table 2.22 Suggested improvements to the Manual Therapy package.

Improvement Theme	Frequency
Marking	1 (13%)
Increased / Improved Access	4 (50%)
Further information sections	1 (13%)
Extend package	2 (25%)
Total	8 (100%)

Most of the suggested improvements were related to increased or improved access (4, 50%).

"It would be very useful if the package could be accessed on any university computer because it would make it easier to access and practice."

(BSc Hons Physiotherapy 2003)

There were 2 (25%) suggestions relating to extending the package;

" Give references so we can look up information and read around it."

(BSc Hons Physiotherapy 2003)

"Expand on areas covered, make it more of a part of the learning process."

(BSc Hons Physiotherapy 2003)

Quantitative tracking data for the manual therapy package

A total of 58 students used the self-study version of the manual therapy package.

Data was collected on the self-study and the test versions of the package;

Self study version

- the amount of times each student attempted this package
- time spent using this package
- the score achieved at each attempt

The improvement in self-study score was then calculated as the difference between the self-study scores on the students first and final attempts.

Test version

- the test score achieved

The following comparisons were made between the data and tested using Spearman's Rho non-parametric correlation:

- Improvement in self-study score against number of attempts and time spent using the self-study version of the Manual Therapy package.
- Test score against number of attempts and time spent using the self-study version of the Manual Therapy package.

Table 2.23 Frequency of attempts by students using the self-study version of the Manual Therapy package.

	Attempts	Frequency	Percent
Valid	1 attempt	16	28
	2 attempts	8	14
	3 attempts	15	26
	4 attempts	10	17
	5 attempts	3	5
	6 attempts	3	5
	8 attempts	1	2
	9 attempts	2	3
	Total	58	100.0

The minimum number of attempts at the self-study version of the package was one by 16 (28%) students. The maximum number of attempts was 9 (2, 3%). The median number of attempts by the students at the self-study version of the manual therapy package was 3.

Table 2.24 Showing number of times accessed for the self-study version of the Manual Therapy package.

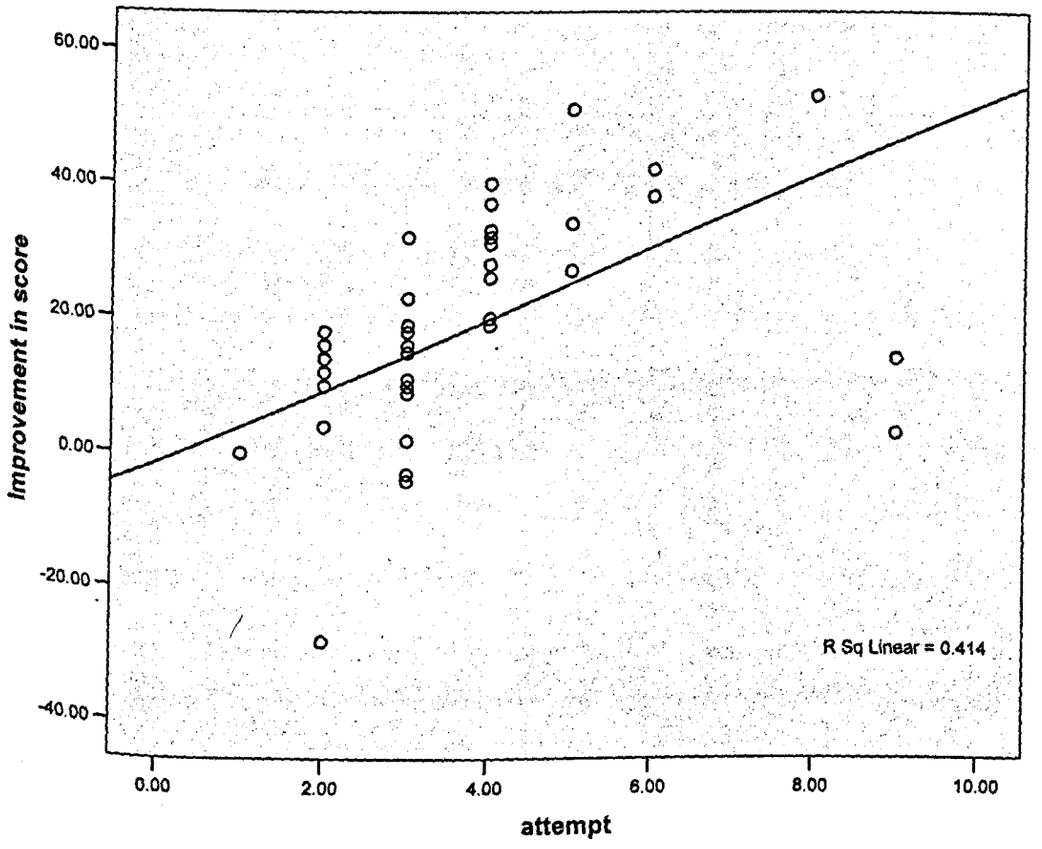
Time in minutes		Frequency	Percent
Valid	0-20.00	4	6.9
21 to	30.00	5	8.6
31 to	40.00	16	27.6
41 to	50.00	11	19.0
51 to	60.00	2	3.4
61 to	70.00	5	8.6
71 to	80.00	6	10.3
81 to	90.00	3	5.2
91 to	100.00	3	5.2
Over	100	3	5.2
	Total	58	100.0

The minimum time spent using the self-study version of the package was 9 minutes. The longest amount of time spent using the self-study version of the package was 237 minutes (3 hours 57 minutes). The median amount of time spent by students using the self-study version of the manual therapy package was 43 minutes.

Self study scores for student using the Manual Therapy package ranged from 6% to 90%, the mean self-study score being 50%.

The Manual Therapy test results followed a normal distribution when tested using the Kolmogorov-Smirnov test. Test scores ranged from 14% to 77%, the mean test score being 50%.

Fig. 2.2 Scatterplot of number of attempts against improvement in score for the Manual Therapy package.



From the graph it can be seen that there is a tendency for the amount of improvement to increase as the number of attempts increases until the 9th attempt. A Spearman's Rho correlation coefficient was used to determine whether there was a significant relationship between improvement in score and the number of attempts for the self-study version of the manual therapy package.

Table 2.25 Spearman's Rho correlation for attempts and improvement.

Correlations

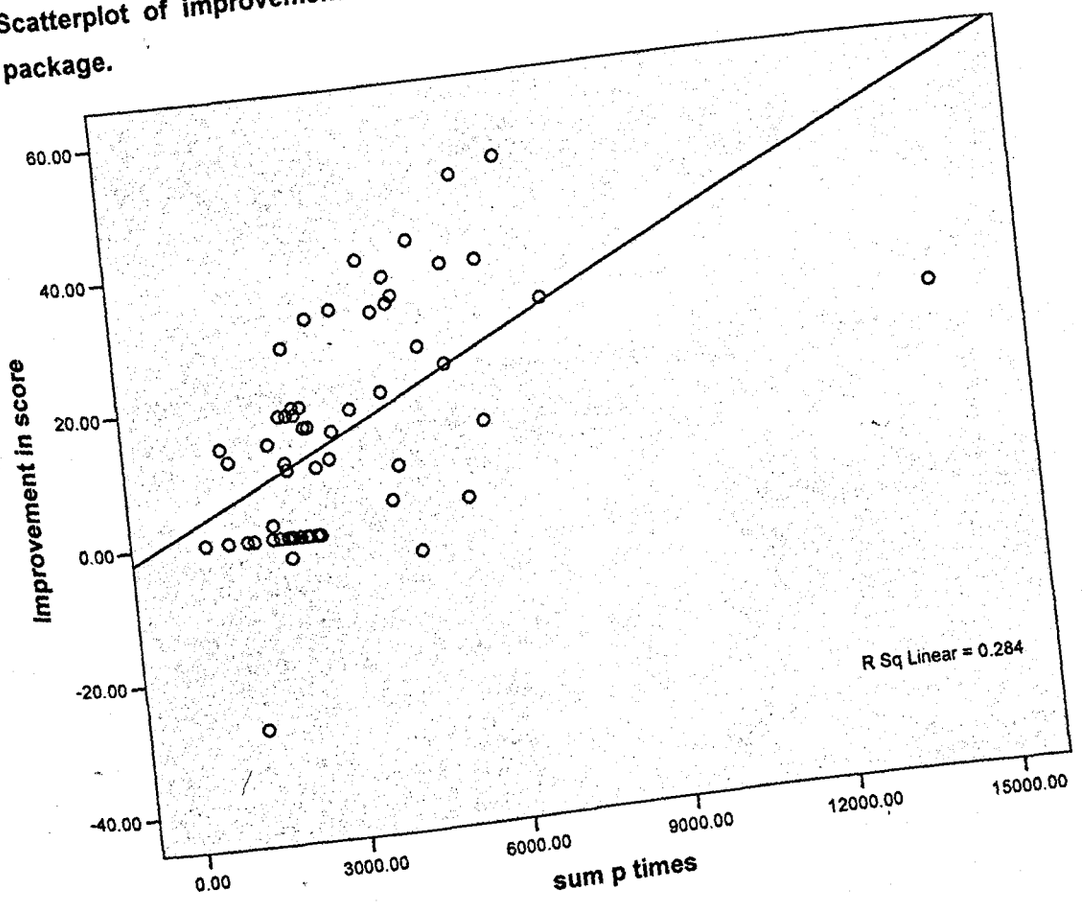
			attempt	Improvement in score
Spearman's rho	attempt	Correlation Coefficient	1.000	.803**
		Sig. (2-tailed)	.	.000
		N	58	58
	Improvement in score	Correlation Coefficient	.803**	1.000
		Sig. (2-tailed)	.000	.
		N	58	58

**. Correlation is significant at the 0.01 level (2-tailed).

There is a significant relationship between improvement in score and number of attempts using the self-study version of the package. The strength of the relationship is strongly positive (0.803).

The amount of improvement in self-study score was also compared to the length of time each student spent using the package.

Fig 2.3 Scatterplot of improvement in score against time spent using the Manual Therapy package.



From the graph there is a tendency for improvement in score to increase with the amount of time spent using the self-study package. A Spearman's Rho correlation coefficient was used to determine whether there was a significant relationship between improvement in score and time spent using the self-study version of the manual therapy package.

Table 2.26 Spearman's Rho correlation for improvement in score and time spent using the manual therapy self-study package.

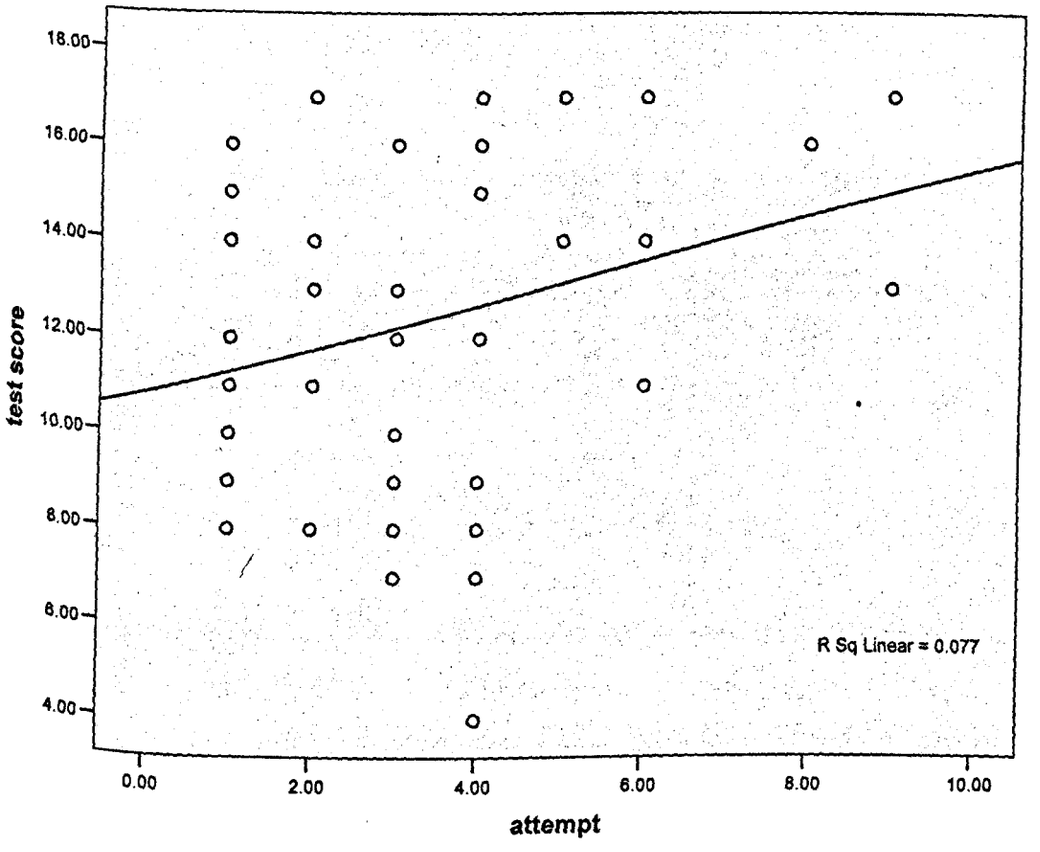
			Improvement in score	sum p times
Spearman's rho	Improvement in score	Correlation Coefficient	1.000	.629(**)
		Sig. (2-tailed)	.	.000
		N	58	58
	sum p times	Correlation Coefficient	.629(**)	1.000
		Sig. (2-tailed)	.000	.
		N	58	58

** Correlation is significant at the 0.01 level (2-tailed).

There is a significant relationship between improvement in score and time spent using the self-study version of the package. The strength of the relationship is moderately positive (0.629).

The number of attempts with the self-study version and the score achieved in the test version were compared.

Fig 2.4 Scatterplot of test score against number of attempts with the Manual Therapy package.



There is a slight tendency for the test score to increase with the number of attempts with the self–study version of the package. A Spearman's Rho correlation coefficient was used to determine whether there was a significant relationship between test score and number of attempts with the self –study version of the manual therapy package.

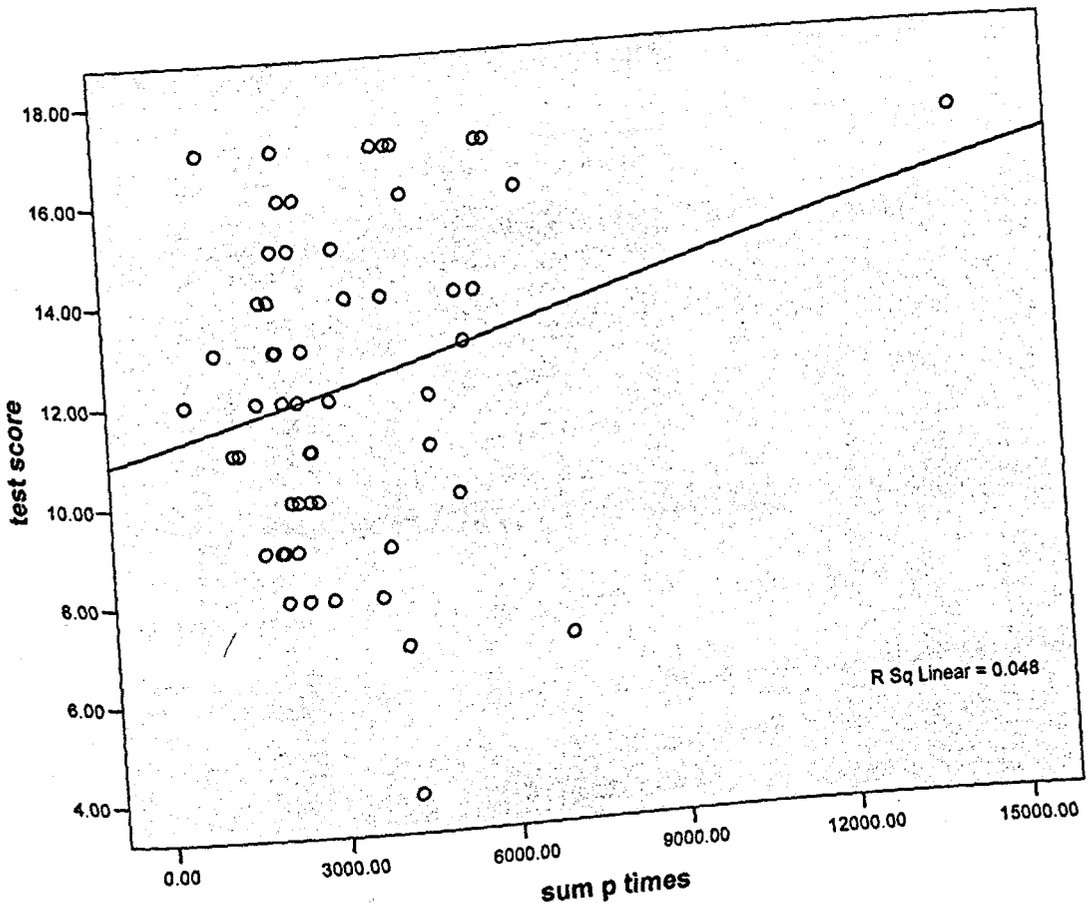
Table 2.27 Spearman's Rho correlation coefficient of test score and number of attempts with the self-study version of the Manual Therapy package.

			test score	attempt
Spearman's rho	test score	Correlation Coefficient	1.000	.250
		Sig. (2-tailed)	.	.066
		N	55	55
	attempt	Correlation Coefficient	.250	1.000
		Sig. (2-tailed)	.066	.
		N	55	58

A significant relationship does not exist between test score and number of attempts with the self-study version of the manual therapy package.

The test score and the time spent using the self-study version of the manual therapy package were compared.

Fig 2.5 Scatterplot of test score against time spent using the Manual Therapy package.



There is a slight tendency for the test score to increase as the amount of time spent with the self–study version of the manual therapy package increases. A Spearman's Rho correlation coefficient was used to determine if there was a significant relationship between the test score and the amount of time spent with the self –study version of the manual therapy package.

Table 2.28 Spearman's Rho correlation coefficient of test score and amount of time spent with the self-study version of the Manual Therapy package.

			sum p times	test score
Spearman's rho	sum p times	Correlation Coefficient	1.000	.168
		Sig. (2-tailed)	.	.219
		N	58	55
	test score	Correlation Coefficient	.168	1.000
		Sig. (2-tailed)	.219	.
		N	55	55

A significant relationship does not exist between test score and time spent using the self-study version of the manual therapy package.

Section 3 Stroke Package

Demographic Information

The numbers of students in each group, their ages and genders are presented in the following tables.

Three groups of students used and evaluated the manual therapy package. These groups comprised the following numbers of students:

Table 3.1 Groups of students evaluating the Stroke package.

Group	Number of students in year	Students completing evaluation
BSc Hons PT 2003	46	43
BSc Hons OT 2003	38	34
MSc PT 2004	23	18
Total	107	95

The largest group evaluating the stroke package was the BSc Hons Physiotherapy group and the smallest was the MSc pre-registration Physiotherapy group. The age and gender distribution of each group was as follows:

Table 3.2 Gender distribution of students per group.

		Group			Total
		BSc Hons PT 2003	BSc Hons OT 2003	MSc PT 2004	
Gender	Male	11	2	5	18
	Female	32	32	13	77
Total		43	34	18	95

There were 77 female students and 18 male students who evaluated the stroke package. All groups had a greater ratio of female to male students.

Table 3.3 Age distribution of students per group.

		Group			Total
		BSc Hons PT 2003	BSc Hons OT 2003	MSc PT 2004	
Age	27 and under	42	31	15	88
	28 and over	1	3	3	7
Total		43	34	18	95
Percentage of mature students per group		2%	9%	17%	7%

In all groups there was a higher number of students age 27 and under, only 7% of students overall being 28 years or over.

Likert scale responses and ranking of delivery modes.

This section reports student attitudes towards computers, confidence in various computer-based activities, and attitudes towards different features of the stroke package, which were elicited using Likert scales. Students were also asked to rank their preferred modes of delivery for learning about stroke.

Attitudes towards computers were as follows. Agreement with the following statements was considered to indicate a positive attitude towards computers.

- Anyone can use a computer.
- Computer Literacy will make me more employable

Agreement with the following statements was considered to indicate a negative attitude towards computers.

- I find a computer difficult to use.
- Computers isolate you from other people.
- I am afraid of looking silly if I make a mistake while using the computer.

Attitudes towards computers were elicited from the student groups and these were as follows:

Table 3.4 Attitudes to computers for students evaluating the Stroke package.

Statements about Computers	Total response	Level of Agreement			
		Strongly disagree	Disagree	Agree	Strongly agree
Anyone can use a computer.	(*n*=95)	0	2 (2%)	60 (63%)	33 (35%)
I find a computer difficult to use.	(*n*=95)	24 (25%)	66 (70%)	3 (3%)	2 (2%)
Computers isolate you from other people.	(*n*=95)	8 (8%)	58 (61%)	28 (30%)	1 (1%)
Computer literacy will make me more employable.	(*n*=95)	2 (2%)	2 (2%)	56 (59%)	35 (37%)
I am afraid of looking silly if making a mistake while using the computer.	(*n*=95)	21 (22%)	61 (64%)	13 (14%)	0

(*n* = total number of students responding to each scale)

Students exhibited mainly positive attitudes towards computers with 91 (96%) agreeing or strongly agreeing that computer literacy will make them more employable and 93 (98%) agreeing or strongly agreeing that anyone can use a computer. The majority also disagreed or strongly disagreed that they found computers difficult to use (90, 95%) or that they were afraid of looking silly making a mistake while using the computer (82, 86%). However 31% of students did agree or strongly agreeing computers isolate you from other people.

Table 3.5 Key to response codes for attitudes towards computers.

Response	Code	
	Positive statements	Negative statements
Strongly Disagree	1	4
Disagree	2	3
Agree	3	2
Strongly Agree	4	1

For all statements the median value was 3 indicating positive attitudes on average throughout the statements.

Students' responses to their level of confidence with different computer based activities were as follows;

Table 3.6 Confidence with different computer-based activities.

Computer based activity	Total response	Level of confidence				
		No confidence	Little confidence	Some confidence	confident	Very confident
web based	(*n*=86)	0	1 (1%)	5 (6%)	58 (67%)	22 (26%)
Navigating materials on-line	(*n*=86)	0	2 (2%)	9 (11%)	58 (67%)	17 (20%)
reading on-line	(*n*=86)	0	1 (1%)	13 (15%)	57 (66%)	15 (17%)
Using multimedia	(*n*=86)	1 (1%)	1 (1%)	16 (19%)	59 (69%)	9 (11%)
Study independently	(*n*=86)	1 (1%)	1 (1%)	1 (1%)	58 (67%)	25 (29%)
self study	(*n*=86)	2 (2%)	1 (1%)	12 (14%)	56 (65%)	15 (17%)

(*n* = total number of students responding to each scale)

Students identified that they were mainly confident or very confident in all the above computer based activities. Studying independently at a computer elicited the greatest number of very confident responses (25, 29%). Using computers for self-study elicited the greatest number of responses for little or no confidence (3, 3%).

Table 3.7 Key to response codes for confidence in computer-based activities.

Response	Code
No Confidence	1
Little confidence	2
Some confidence	3
Confident	4
Very confident	5

The median value for all categories was 4 indicating that on average students were confident with these computer based activities.

Students' attitudes towards statements about the stroke package are as follows.

Table 3.8 Students' attitudes towards the Stroke package.

Statements about the package	Total response	Level of Agreement			
		Strongly disagree	Disagree	Agree	Strongly agree
It is clear what options are open to you at each stage.	(*n*=95)	0	2 (2%)	73 (77%)	20 (21%)
It is easy to navigate to where you want to go.	(*n*=95)	0	2 (2%)	73 (77%)	20 (21%)
There are clear instructions on how to use the package.	(*n*=95)	0	0	73 (77%)	22 (23%)
There are consistent procedures throughout the package.	(*n*=95)	0	1 (1%)	73 (77%)	21 (22%)
The videos are worthwhile and supported my learning.	(*n*=95)	0	4 (4%)	48 (50%)	43 (45%)
The information on screen is easy to read.	(*n*=95)	0	1 (1%)	59 (62%)	35 (37%)
The presentation is informative.	(*n*=95)	0	3 (3%)	60 (63%)	32 (34%)
The package is enjoyable to use.	(*n*=95)	0	8 (8%)	73 (77%)	14 (15%)
It helps you to learn about the topic.	(*n*=95)	0	7 (7%)	52 (55%)	36 (38%)
It fits well with the rest of my course material.	(*n*=95)	0	4 (4%)	66 (70%)	25 (26%)
The time spent using the package is well worth it.	(*n*=94)	1 (1%)	9 (10%)	72 (77%)	12 (13%)
It would help me to revise the subject	(*n*=94)	1 (1%)	4 (4%)	61 (64%)	28 (30%)
I feel more confident towards computer assisted study materials.	(*n*=95)	0	9 (10%)	69 (73%)	17 (18%)
It has allowed me access to a useful resource.	(*n*=95)	0	4 (4%)	70 (74%)	21 (22%)

(*n* = total number of students responding to each scale)

Students overall attitudes towards the package were positive with at least 89% of the students agreeing or strongly agreeing with all the statements. The statement;

"There are clear instructions on how to use the package."

elicited the greatest proportion of agreement or strong agreement from 95 (100%) students.

The following statement elicited the greatest proportion of disagreement or strong disagreement from 10 (11%) students.

"The time spent using the package is well worth it."

Table 3.9 Key to response codes for attitudes towards the Stroke package.

Response	Code
Strongly disagree	1
Disagree	2
Agree	3
Strongly agree	4

The median values for all statements are 3 indicating an average agreement with the statements and reflecting positive attitudes towards the stroke package.

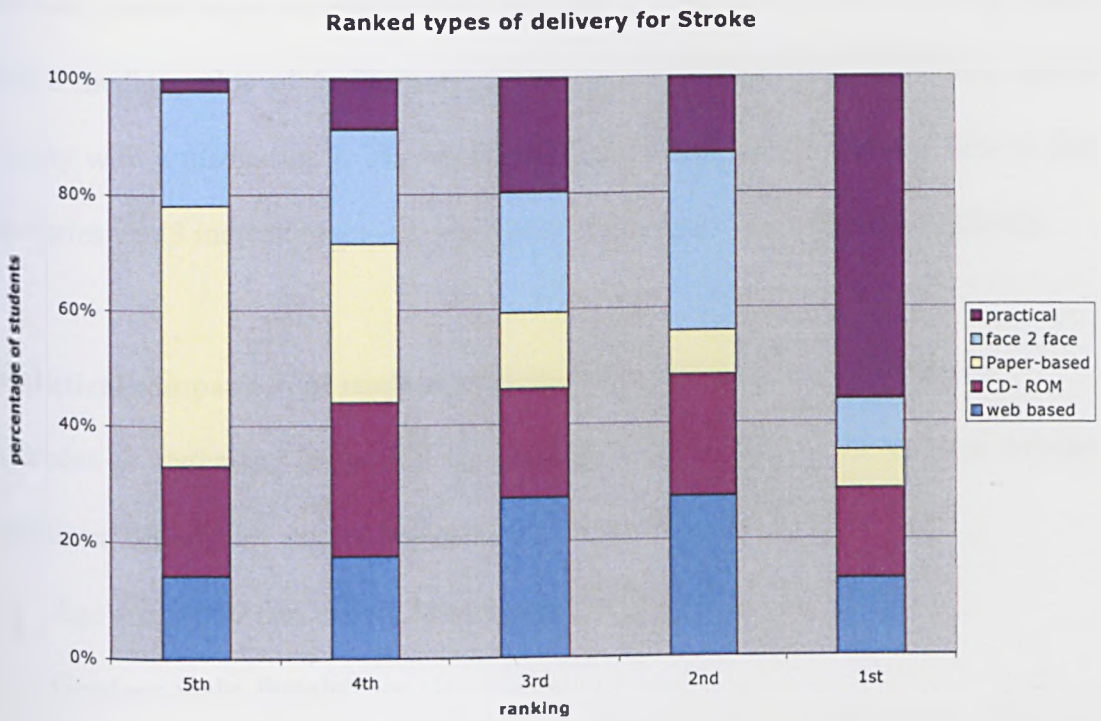
Students were asked to rank their preferred methods of delivery for learning about stroke the results are as follows;

Table 3.10 Ranking of different types of delivery for stroke.

Types of Computer based Activity	Total response	Order of ranking				
		Ranked 5th	Ranked 4th	Ranked 3rd	Ranked 2nd	Ranked 1st
web based	(n=91)	13 (14%)	16 (18%)	25 (28%)	25 (28%)	12 (13%)
CD- ROM	(n=91)	17 (19%)	24 (26%)	17 (19%)	19 (21%)	14 (15%)
Paper-based study	(n=)	41 (45%)	25 (28%)	12 (13%)	7 (8%)	6 (7%)
Face to face teaching	(n=)	18 (20%)	18 (20%)	19 (21%)	28 (31%)	8 (9%)
Practical class	(n=)	2 (2%)	8 (9%)	18 (20%)	12 (13%)	51 (56%)

(*n* = total number of students ranking each delivery method)

Fig 3.1



The favoured method of delivery for stroke was the practical class with 51 (56%) students ranking this first. Most students ranked face to face teaching second (28, 31%). The method most commonly ranked third was web based learning (25, 28%). Learning via CD-ROM (24.26%) and paper based study (25, 28%) were the learning methods most commonly ranked fourth. 41 (45%) of students ranked paper based study as their least favoured way of learning about stroke.

Table 3.11 Key to response codes for ranking types of delivery for stroke.

Rank	Code
1st	5
2nd	4
3rd	3
4th	2
5th	1

Practical classes were on average the most highly ranked form of delivery for stroke with a median value of 5. Paper based activity on average was the lowest ranked activity with a median of 1. The median rating for web-based, CD and face to face deliveries was 3 indicating that on average students rated these deliveries midway.

Statistical comparison of student attitudes towards the Stroke package.

Attitudes to statements regarding the package were compared to discover whether significant differences existed between;

i. Age groups; 27 and under, 28 and over.

ii. Genders; male, female

iii. Groups; BSc (Hons) Physiotherapy 2003, MSc (pre-reg.) Physiotherapy 2004, BSc (Hons) Occupational Therapy 2003

The Mann-Whitney U test was used to compare and test age groups and genders, as these comprise two independent samples. The Kruskal Wallis was used to compare student groups, as these comprise three independent samples and the Mann-Whitney U test was used for post hoc testing to identify significant differences between each of the groups. The Bonferoni correction was set at 0.016 (Argyrous 2000).

Table 3.12a Students' attitudes towards the Stroke package by age group.

Statements about the package	*Total Response*		*Level of Agreement*							
	27 and under	28 and over	Strongly disagree		Disagree		Agree		Strongly agree	
			27 and under	28 and over	27 and under	28 and over	27 and under	28 and over	27 and under	28 and over
It is clear what options are open to you at each stage.	88	7	0	0	1 (1%)	1 (14%)	68 (77%)	5 (71%)	19 (22%)	1 (14%)
It is easy to navigate to where you want to go.	88	7	0	0	2 (2%)	0	66 (75%)	7 (100%)	20 (23%)	0
There are clear instructions on how to use the package.	88	7	0	0	0	0	68 (77%)	5 (71%)	20 (23%)	2 (29%)
There are consistent procedures throughout the package.	88	7	0	0	1 (1%)	0	66 (75%)	7 (100%)	21 (24%)	0
The videos are worthwhile and supported my learning.	88	7	0	0	4 (5%)	0	43 (49%)	5 (71%)	41 (47%)	2 (29%)
The information on screen is easy to read.	88	7	0	0	1 (1%)	0	55 (63%)	4 (57%)	32 (36%)	3 (43%)
The presentation is informative.	88	7	0	0	2 (2%)	1 (14%)	55 (63%)	5 (71%)	31 (35%)	1 (14%)
The package is enjoyable to use.	88	7	0	0	7 (8%)	1 (14%)	67 (76%)	6 (86%)	14 (16%)	0

Table 3.12b Students' attitudes towards the Stroke package by age group.

Statements about the package	Total Response		Level of Agreement							
	27 and under	28 and over	Strongly disagree		Disagree		Agree		Strongly agree	
			27 and under	28 and over	27 and under	28 and over	27 and under	28 and over	27 and under	28 and over
It helps you to learn about the topic.	88	7	0	0	6 (7%)	1 (14%)	47 (53%)	5 (71%)	35 (40%)	1 (14%)
It fits well with the rest of my course material.	88	7	0	0	4 (5%)	0	60 (68%)	6 (86%)	24 (27%)	1 (14%)
The time spent using the package is well worth it.	88	6	1 (1%)	0	8 (9%)	1 (17%)	68 (77%)	4 (67%)	11 (13%)	1 (17%)
It would help me to revise the subject.	87	7	1 (1%)	0	2 (2%)	2 (29%)	59 (68%)	2 (29%)	25 (29%)	3 (43%)
I feel more confident towards computer assisted study materials.	88	7	0	0	8 (9%)	1 (14%)	64 (73%)	5 (71%)	16 (18%)	1 (14%)
It has allowed me access to a useful resource.	88	7	0	0	4 (5%)	0	64 (73%)	6 (86%)	20 (23%)	1 (14%)

Age Group Comparison

Most students from both age groups agreed with the positive statements about the stroke package.

3 students aged 28 and over strongly agreed with the statements

"The information on screen is easy to read."

"It would help me to revise the subject."

The statement:

"The videos are worthwhile and supported my learning."

Elicited the highest proportion of strong agreement in students aged 27 and under (41, 47%)

All the students (7, 100%) in the 28 and over age group agreed with the statements:

"It is easy to navigate where you want to go."

"There are consistent procedures throughout the package."

68 (77%) of students in the 27 and under age group agreed with the statements:

" It is clear what options are open to you at each stage."

"There are clear instructions on how to use the package."

"The time spent using the package is well worth it."

2 students aged 28 and over disagreed that:

"It would help me to revise the subject."

8 students aged 27 and under disagreed that:

"The time spent using the package is well worth it."

" I feel more confident towards computer assisted study materials."

No students aged 28 and over strongly disagreed with any of the positive statements about the stroke package.

1 student aged 27 and under strongly disagreed that:

"The time spent using the package is well worth it."

"It would help me to revise the subject."

There were no significant findings for comparison between age groups.

Table 3.13a Students' attitudes towards the Stroke package by gender.

Statements about the package	Total Response		Level of Agreement							
	Male	Female	Strongly disagree		Disagree		Agree		Strongly agree	
			Male	Female	Male	Female	Male	Female	Male	Female
It is clear what options are open to you at each stage.	18	77	0	0	1 (6%)	1 (1%)	13 (72%)	60 (78%)	4 (22%)	16 (21%)
It is easy to navigate to where you want to go.	18	77	0	0	0	2 (3%)	15 (83%)	58 (75%)	3 (17%)	17 (22%)
There are clear instructions on how to use the package.	18	77	0	0	0	0	15 (83%)	58 (75%)	3 (17%)	19 (25%)
There are consistent procedures throughout the package.	18	77	0	0	0	1 (1%)	13 (72%)	60 (78%)	5 (28%)	16 (21%)
The videos are worthwhile and supported my learning.	18	77	0	0	1 (6%)	3 (4%)	9 (50%)	39 (51%)	8 (44%)	35 (46%)
The information on screen is easy to read.	18	77	0	0	1 (6%)	0	11 (61%)	48 (62%)	6 (33%)	29 (38%)
The presentation is informative.	18	77	0	0	1 (6%)	2 (3%)	13 (72%)	47 (61%)	4 (22%)	28 (36%)
The package is enjoyable to use.	18	77	0	0	1 (6%)	7 (9%)	13 (72%)	60 (78%)	4 (22%)	10 (13%)

Table 3.13b Students' attitudes towards the Stroke package by gender.

Statements about the package	Total Response		Level of Agreement							
	Male	Female	Strongly disagree		Disagree		Agree		Strongly agree	
			Male	Female	Male	Female	Male	Female	Male	Female
It helps you to learn about the topic.	18	77	0	0	1 (6%)	6 (8%)	13 (72%)	39 (51%)	4 (22%)	32 (42%)
It fits well with the rest of my course material.	18	77	0	0	1 (6%)	3 (4%)	12 (67%)	54 (70%)	5 (28%)	20 (26%)
The time spent using the package is well worth it.	18	76	1 (6%)	0	0	9 (12%)	15 (83%)	57 (75%)	2 (11%)	10 (13%)
It would help me to revise the subject.	18	76	1 (6%)	0	1 (6%)	3 (4%)	10 (56%)	51 (67%)	6 (33%)	22 (29%)
I feel more confident towards computer assisted study materials.	18	77	0	0	1 (6%)	8 (10%)	14 (78%)	55 (71%)	3 (17%)	14 (18%)
It has allowed me access to a useful resource.	18	77	0	0	1 (6%)	3 (4%)	15 (83%)	55 (71%)	2 (11%)	19 (25%)

Gender Group Comparison

Most students from both genders agreed with the positive statements about the stroke package.

The statement:

"The videos are worthwhile and helped my learning."

Elicited the highest proportion of strong agreement from male students (8,44%).

The statement:

"It helps you to learn about the topic."

Elicited the highest proportion of strong agreement from female students (32, 42%)

15 (83%) male students agreed that:

"The time spent using the package is well worth it."

"There are clear instructions on how to use the package."

"It is easy to navigate where you want to go."

" It has allowed me access to a useful resource."

60 (78%) female students agreed that:

"There are consistent procedures throughout the package."

" It is clear what options are open to you at each stage."

"The package is enjoyable to use."

1 (6%) male student disagreed with the following statements:

" It is clear what options are open to you at each stage."

"The videos are worthwhile and helped my learning."

" The information on screen is easy to read."

"The presentation is informative."

"The package is enjoyable to use."

"It helps you to learn about the topic."

"It fits well with the rest of my course material."

"It would help me revise the subject."

" I feel more confident towards computer assisted study materials."

" It has allowed me access to a useful resource."

9 (12%) female students disagreed that:

"The time spent using the package is well worth it."

1 (6%) male student strongly disagreed that:

"The time spent using the package is well worth it."

"It would help me revise the subject."

No female students strongly disagreed with any of the positive statements about the package.

There were no significant findings for comparison between genders.

Table 3.14a Students' attitudes towards the Stroke package by group.

Group	Level of agreement	Statements about the package				
		It is clear what options are open to you at each stage.	It is easy to navigate to where you want to go.	There are clear instructions on how to use the package.	There are consistent procedures throughout the package.	The videos are worthwhile and supported my learning.
BSc Hons PT 2003	Strongly disagree	0	0	0	0	0
	Disagree	1 (2%)	0	0	1 (2%)	1 (2%)
	Agree	32 (74%)	36 (84%)	35 (81%)	32 (74%)	20 (47%)
	Strongly agree	10 (23%)	7 (16%)	8 (19%)	10 (23%)	22 (51%)
	Total	43	43	43	43	43
MSc (pre-reg.) PT 2004	Strongly disagree	0	0	0	0	0
	Disagree	0	0	0	0	3 (17%)
	Agree	15 (83%)	15 (83%)	14 (78%)	16 (89%)	11 (61%)
	Strongly agree	3 (17%)	3 (17%)	4 (22%)	2 (11%)	4 (22%)
	Total	18	18	18	18	18
BSc Hons OT 2003	Strongly disagree	0	0	0	0	0
	Disagree	1 (3%)	2 (6%)	0	0	0
	Agree	26 (77%)	22 (65%)	24 (71%)	25 (74%)	17 (50%)
	Strongly agree	7 (21%)	10 (29%)	10 (29%)	9 (27%)	17 (50%)
	Total	34	34	34	34	34

Table 3.14b Students' attitudes towards the Stroke package by group.

Group	Level of agreement	Statements about the package				
		The information on screen is easy to read.	The presentation is informative.	The package is enjoyable to use.	It helps you to learn about the topic.	It fits well with the rest of my course material.
BSc Hons PT 2003	Strongly disagree	0	0	0	0	0
	Disagree	0	0	1 (2%)	2 (5%)	0
	Agree	27 (63%)	28 (65%)	35 (81%)	25 (58%)	31 (72%)
	Strongly agree	16 (37%)	15 (5%)	7 (16%)	16 (37%)	12 (28%)
	Total	43	43	43	43	43
MSc (pre-reg.) PT 2004	Strongly disagree	0	0	0	0	0
	Disagree	1 (6%)	2 (11%)	5 (28%)	5 (28%)	2 (11%)
	Agree	12 (67%)	14 (78%)	12 (67%)	9 (50%)	13 (72%)
	Strongly agree	5 (28%)	2 (11%)	1 (6%)	4 (22%)	3 (17%)
	Total	18	18	18	18	18
BSc Hons OT 2003	Strongly disagree	0	0	0	0	0
	Disagree	0	1 (3%)	2 (6%)	0	2 (6%)
	Agree	20 (59%)	18 (53%)	26 (77%)	18 (53%)	22 (65%)
	Strongly agree	14 (41%)	15 (44%)	6 (18%)	16 (47%)	10 (29%)
	Total	34	34	34	34	34

Table 3.14c Students' attitudes towards the Stroke package by group.

Group	Level of agreement	Statements about the package			
		The time spent using the package is well worth it.	It would help me to revise the subject.	I feel more confident towards computer assisted study materials.	It has allowed me access to a useful resource.
BSc Hons PT 2003	Strongly disagree	0	0	0	0
	Disagree	2 (5%)	1 (2%)	3 (7%)	1 (2%)
	Agree	34 (79%)	26 (61%)	33 (77%)	33 (77%)
	Strongly agree	7 (16%)	16 (37%)	7 (16%)	9 (21%)
	Total	43	43	43	43
MSc (pre-reg.) PT 2004	Strongly disagree	1 (6%)	1 (6%)	0	0
	Disagree	6 (33%)	3 (18%)	6 (33%)	3 (17%)
	Agree	11 (61%)	10 (59%)	12 (67%)	15 (83%)
	Strongly agree	0	3 (18%)	0	0
	Total	18	17	18	18
BSc Hons OT 2003	Strongly disagree	0	0	0	0
	Disagree	1 (3%)	0	0	0
	Agree	27 (82%)	25 (74%)	24 (71%)	22 (65%)
	Strongly agree	5 (15%)	9 (27%)	10 (29%)	12 (35%)
	Total	33	34	34	34

Course Group Comparison

Most students in all course groups agreed with the positive statements about the stroke package.

The statement:

"The videos are worthwhile and supported my learning."

Elicited the highest proportion of strong agreement from 22, (51%) of BSc Hons Physiotherapy intake 2003 and 17, 50% BSc Hons Occupational Therapy intake 2003 students.

The statement:

"The information on screen is easy to read."

Elicited the highest proportion of strong agreement from 5 (28%) MSc (pre-reg.) Physiotherapy intake 2004.

36 (84%) students in BSc (Hons) Physiotherapy intake 2003 agreed with the statement:

"It is easy to navigate where you want to go."

16 (89%) students in the MSc (pre-reg.) Physiotherapy intake 2004 agreed that:

"There are consistent procedures throughout the package."

27 (82%) students in the BSc (Hons) Occupational Therapy intake 2003 agreed that:

"The time spent using the package was well worth it."

3 students in BSc (Hons) Physiotherapy intake 2003 disagreed with the statement:

"I feel more confident towards computer assisted study materials."

6 (33%) students in the MSc (pre-reg.) Physiotherapy intake 2004 disagreed that:

"I feel more confident towards computer assisted study materials."

"The time spent using the package was well worth it."

2 (6%) students in the BSc (Hons) Occupational Therapy intake 2003 disagreed that:

"It is easy to navigate where you want to go."

"The package is enjoyable to use."

"It fits well with the rest of my course material."

None of the students in the BSc (Hons) Physiotherapy intake 2003 or BSc (Hons) Occupational Therapy intake 2003 strongly disagreed with any of the positive statements about the stroke package.

1 student in the MSc (pre-reg.) Physiotherapy intake 2004 strongly disagreed that:

"The time spent using the package was well worth it."

"It would help em to revise the subject."

There was a significant difference between the three students groups regarding levels of agreement and disagreement with the following statements;

- *The videos are worthwhile and supported my learning. ($p=0.029$)*
- *The presentation is informative. ($p=0.027$)*
- *The package is enjoyable to use. ($p=0.023$).*
- *The package helps you to learn about the topic. ($p=0.026$)*
- *The time spent using the package is well worth it. ($p=0.000$)*
- *I feel more confident towards computer assisted study materials. ($p=0.000$)*
- *It has allowed me access to a useful resource. ($p=0.002$)*

Post hoc tests were carried out using Mann-Whitney U tests to discover which of the three groups elicited these significant differences. The level of significance for these tests was decided using the Bonferoni correction and thus set at $p<0.016$.

Proportions of disagreement and agreement relevant to each significant finding are also given.

MSc (pre reg.) Physiotherapy compared with BSc (Hons) Occupational Therapy

28% MSc (pre-reg.) Physiotherapy intake 2004 students and no BSc (Hons) Occupational Therapy intake 2003 students disagreed with the statement:

- The package helps you to learn about the topic. (p=0.009)

39% MSc (pre-reg.) Physiotherapy intake 2004 and only 3% BSc (Hons) Occupational Therapy intake 2003 students disagreed with the statement:

- The time spent using the package is well worth it. (p=0.001)

33% MSc (pre-reg.) Physiotherapy intake 2004 and no BSc (Hons) Occupational Therapy intake 2003 students disagreed with the statement:

- I feel more confident towards computer assisted study materials. (p=0.000)

17% MSc (pre-reg.) Physiotherapy intake 2004 and no BSc (Hons) Occupational Therapy intake 2003 students disagreed with the statement:

- It has allowed me access to a useful resource. (p=0.001)

MSc (pre reg.) Physiotherapy compared with BSc (Hons) Physiotherapy

17% MSc (pre-reg.) Physiotherapy intake 2004 and 2% BSc (Hons) Physiotherapy intake 2003 students disagreed with the statement:

- The videos are worthwhile and supported my learning. (p=0.015)

28% MSc (pre-reg.) Physiotherapy intake 2004 and 2% BSc (Hons) Physiotherapy intake 2003 students disagreed with the statement:

- The package is enjoyable to use. (p=0.008).

39% MSc (pre-reg.) Physiotherapy intake 2004 either strongly disagreed or disagreed and 5% BSc (Hons) Physiotherapy intake 2003 students disagreed with the statement:

- The time spent using the package is well worth it. (p=0.000)

33% MSc (pre-reg.) Physiotherapy intake 2004 and 7% BSc (Hons) Physiotherapy intake 2003 students disagreed with the statement:

- I feel more confident towards computer assisted study materials. (p=0.003)

17% MSc (pre-reg.) Physiotherapy intake 2004 and 2% BSc (Hons) Physiotherapy intake 2003 students disagreed with the statement:

- It has allowed me access to a useful resource. (p=0.006)

BSc (Hons) Occupational Therapy compared with BSc (Hons) Physiotherapy

There were no significant differences found between these groups regarding attitudes towards the stroke package.

Open response questions

Students were asked the following open response questions;

1. How, if at all, do you think the stroke package has affected your general knowledge of stroke?

2. How, if at all, do you think the stroke package has affected your understanding of stroke?

3. How do you think you might apply what you have learned in the future?

4. Please give up to three reasons for liking or disliking the stroke package.

5. On reflection how do you think the package has affected your learning?

These responses were categorised into positive, equivocal and negative responses and then further analysed into common themes. The results of the analysis were as follows;

Table 3.15 Stroke package open responses. (*n*=398)

Question	Positive responses	Equivocal responses	Negative responses
General Knowledge	68 (17%)	11 (3%)	4 (1%)
Understanding	69 (17%)	9 (2%)	4(1%)
Application	57 (14%)	5 (1%)	5 (1%)
Reflection on learning	74 (19%)	15 (4%)	9 (2%)
Total	336 (84%)	40 (10%)	22(6%)

(*n*= number of comments per package rather than number of students as each student could make as many comments as they wished. Percentages have been rounded up to the nearest whole number.)

There were 336 (84%) positive comments made by students evaluating the stroke package. There were 40 (10%) equivocal comments and 22 (6%) negative comments made. Most of the positive comments (74, 19%) in the stroke package evaluation were related to reflection on the learning experience.

" I think it was quite an effective way of learning as it made stroke seem more realistic."

(BSc Hons Occupational Therapy 2003)

Most equivocal comments (15, 4%) in the stroke evaluation were also from students reflecting on the effect of the package on their learning.

"I don't think I did the package any justice, as I've not had enough time to give the package with the course being so busy unfortunately especially with the access only being on-line. That's why I feel giving us the package on CD would allow me to fit it

into my own schedule better by using it on my computer at home. I feel our practical classes and lectures prepared us for the assessment and they linked well."

(MSc pre-registration Physiotherapy 2004)

Most negative comments (9, 2%) were also from students reflecting on the learning experience.

" I don't feel I learned much."

(BSc Hons Physiotherapy 2003)

Positive comments related to the following themes;

- General Comments

"My general knowledge has greatly improved"

(BSc Hons Physiotherapy 2003)

- Re-enforcement / revision of knowledge

" Good as you can go over and revise practicals."

(BSc Hons Physiotherapy 2003)

- Understanding and use of terminology

"It has helped me with terminology"

(BSc Hons Occupational Therapy 2003)

- Relating knowledge

" I can relate the pathology to the clinical presentation of the condition."

(MSc pre-registration Physiotherapy 2004)

- Self assessment and feedback

" When I get questions wrong there is an explanation which explains the correct answer therefore aiding my understanding."

(BSc Hons Physiotherapy 2003)

- Videos and audio

"It was useful to see how the techniques we use in class are used."

(BSc Hons Physiotherapy 2003)

- Clarification

"It is clearer due to seeing and observing the patient"

(BSc Hons Occupational Therapy 2003)

- Alternative method of study

"More interesting than reading books"

(BSc Hons Occupational Therapy 2003)

- Relevance to clinical / work-based activities

"It highlights key areas in things such as positioning and moving patients and it made you think what way to handle the patient"

(BSc Hons Physiotherapy 2003)

- Related to summative assessment

" Will be helpful when it comes to OSPE (Objective Structured Practical Examination)."

(MSc pre-registration Physiotherapy 2004)

- Ease of use / access

"Easy to use"

(BSc Hons Physiotherapy 2003)

The positive comments made by students for each question are summarised in relation to these themes in the following table.

Table 3.16 Showing positive comment themes per question.

Comment Theme	General knowledge (*n*=83)	Understanding (*n*=82)	Application (*n*=67)	Reflection on learning (*n*=98)	Total Per Theme (*n*=398)
General	18 (22%)	26 (32%)	2 (3%)	20 (20%)	66 (17%)
Reinforces / revises knowledge	8 (10%)	3 (4%)	6 (9%)	8 (8%)	25 (6%)
Understanding / Using terminology	3 (4%)	1 (1%)	0	0	4 (1%)
Relating Knowledge	1(1%)	5 (6%)	0	2 (2%)	8 (2%)
Self assessment / feedback	7 (8%)	4 (5%)	0	4 (4%)	15 (4%)
Video / Audio	24 (29%)	23(28%)	6 (9%)	17 (17%)	70 (18%)
Clarification	1 (1%)	2 (2%)	0	5 (5%)	8 (2%)
Alternative method of study	0	0	0	10 (10%)	10 (3%)
Relevance to clinical / work-based activities	6 (7%)	5 (6%)	39 (58%)	7 (7%)	57 (14%)
Related to Summative assessment	0	0	4 (6%)	0	4 (1%)
Ease of Use/ Access	0	0	0	1 (1%)	1 (0%)
Total comments per question	68 (82%)	69 (84%)	57 (85%)	74 (76%)	268 (67%)

(*n*= total number of open responses to the question for the stroke package)

Most positive open comments for the stroke package related to the videos or audio (70, 18%). Many general comments (66, 17%) and comments relating to relevance to

work-based activities (57, 14%) were also made. The least common theme was ease of use and / or access (1, 0%).

Equivocal comments related to the following themes;

- General comments e.g.

"Has helped slightly."

(MSc pre-registration Physiotherapy 2004)

- Lack of use e.g.

"I need to study more."

(BSc Hons Physiotherapy 2003)

- The need to use other learning activities to supplement the package as it is not a stand-alone package e.g.

"Still require more practical experience"

(MSc pre-registration Physiotherapy 2004)

- Preference for another method of study e.g.

"It has improved slightly with regard to treatment and handling techniques but I still find lectures more informative."

(BSc Hons Physiotherapy 2003)

- Video and audio clips

"Not sure that it affects the way I learn visually it is useful."

(MSc pre-registration Physiotherapy 2004)

The BSc Hons Occupational Therapy intake 2003 also identified that because it was primarily developed with physiotherapy students in mind they felt the package should have a section specifically relating to OT. The theme relating to this includes comments of this nature;

- Related to physiotherapy

" I don't know more about what an OT would do with a stroke patient but I know what a physio does."

(BSc Hons Occupational Therapy 2003)

Table 3.17 Showing equivocal comment themes per question.

Comment Theme	General knowledge (*n*=83)	Understanding (*n*=82)	Application (*n*=67)	Reflection on learning (*n*=98)	Total (*n*=398)
General	4(5%)	6(7%)	3 (4%)	2(2%)	15 (4%)
Lack of use	2(2%)	1(1%)	0	2(2%)	5 (1%)
Not stand alone package	4(5%)	2(2%)	1(1%)	0	7 (2%)
Prefer book / other method of study	0	0	0	2(2%)	2 (1%)
Videos	0	0	0	4(4%)	4 (1%)
Related to Physiotherapy	1 (1%)	0	1(1%)	5 (5%)	7 (2%)
Total Comments per question	11 (13%)	9 (11%)	4 (6%)	15 (15%)	40 (10%)

(*n*= total number of open responses to the question for the stroke package)

Most equivocal open comments for the stroke package were general comments for each question (15, 4%). The least common theme for equivocal comments was related to preference for another form of study (2,1%).

Negative comments related to the following themes;

- General comments e.g.

"Didn't help general knowledge."

(BSc Hons Physiotherapy 2003)

- Preference for another method of study e.g.

"It's not affected the way I learn I still think I'd learn most from a practical where you can try it out."

(BSc Hons Physiotherapy 2003)

- Video and audio clips

"The picture quality was very poor and I feel that this would need to be improved to really gain the most benefit from it."

(MSc pre-registration Physiotherapy 2004)

The BSc Hons Occupational Therapy intake 2003 also identified that because it was primarily developed with physiotherapy students in mind they felt the package should have a section specifically relating to OT. The theme relating to this includes comments of this nature;

- Related to physiotherapy

"The role of the OT in stroke was not covered therefore did not influence the way in which I would apply knowledge provided."

(BSc Hons Occupational Therapy 2003)

Table 3.18 Showing negative comment themes per question.

Comment Theme	General knowledge (*n*=83)	Understanding (*n*=82)	Application (*n*=67)	Reflection on learning (*n*=98)	Total (*n*=398)
General	4 (5%)	4 (5%)	2 (3%)	3 (3%)	13 (3%)
Prefer book / other method of study	0	0	0	2 (2%)	2(1%)
Videos	0	0	2 (3%)	0	2(1%)
Related to Physiotherapy	0	0	1 (1%)	4 (4%)	5(1%)
Total Comments per question	4 (5%)	4 (5%)	5 (7%)	9 (9%)	22(6%)

(*n*= total number of open responses to the question for the stroke package)

Most negative open comments for the stroke package were general comments for each question (13, 3%). A small proportion of negative responses (1%) were related to preference for another study method, the video clips or that it was too heavily related to physiotherapy.

Students were asked whether they liked the stroke package and whether they could suggest any improvements. The results of these questions are summarised as follows;

Table 3.19 Showing frequencies of students' responses regarding liking and suggesting improvements to the stroke package.

Questions	Total response	YES		NO	
		Frequency	Valid Percent	Frequency	Valid Percent
Did you like using the package?	(*n*=94)	84	90	10	11
Can you suggest any improvements?	(*n*=90)	31	34	59	66

Most students (84, 90%) liked using the movement analysis package and less than half thought there should be improvements (31, 34%).

Reasons for liking or not liking the package are summarised in the following tables in relation to their themes;

Table 3.20 Reasons for liking the Stroke package.

Comment Theme	Reasons to like (*n*=132)
General	15 (11%)
Reinforces / revises knowledge	11 (8%)
Understanding / Using terminology	2 (2%)
Relating Knowledge	1 (1%)
Self assessment / feedback	12 (9%)
Video / Audio	30 (23%)
Clarification	7 (5%)
Alternative method of study	13 (10%)
Relevance to clinical / work-based activities	3 (2%)
Related to Summative assessment	0
Ease of Use/ Access	23 (17%)
Total comments per question	117 (89%)

(*n* = total number of responses given for liking or not liking the package)

Students gave a total of 117 (89%) reasons for liking the stroke package. The most common reason given for liking the stroke package was the video clips (30, 23%). Example reasons for liking the package are given below;

" Good visual aids, negative marking makes you think about it more, demonstration of a real setting."

(BSc Hons Physiotherapy 2003)

"It is more realistic being able to see the patient, it identifies gaps in my knowledge, made clear things we had been taught in lectures."

(BSc Hons Occupational Therapy 2003)

"It made me take time to review the information which I wouldn't have done otherwise, applicable to the information we have been covering in class, allows access whenever need for practice."

(MSc pre-registration Physiotherapy 2004)

Reasons for not liking the stroke package are summarised below in relation to their themes;

Table 3.21 Reasons for not liking the Stroke package.

Comment Theme	Reasons for not liking (*n*=132)
General	3(2%)
Prefer book / other method of study	1 (1%)
Technical problems	3 (2%)
Videos	1 (1%)
Confusion about questions / feedback	4 (3%)
Related to Physiotherapy	5 (4%)
Total Comments per question	17 (13%)

Students gave a total of 17 (13%) reasons for not liking the stroke package. The most common reason given for not liking the stroke package was that it was too heavily related to physiotherapy (5, 4%). Example reasons for not liking the package are given below;

"It wasn't very OT orientated, had it been I would have enjoyed it more, although it didn't count towards passing the module it took a lot of focus at a busy time."

(BSc Hons Occupational Therapy 2003)

"I disliked negative marking and not knowing how many answers to fill in."

(BSc Hons Physiotherapy 2003)

Students were asked to suggest improvements to the stroke package and these are summarised below in relation to their common themes.

Table 3.22 Suggested improvements to the Stroke package.

Improvement theme	Frequency	Percentage
Marking	3	10
Length	5	17
Increased / Improved access	7	24
Videos	3	10
Extend package	6	21
Easier to use	1	3
OT section	3	10
Layout	1	3
Total	29	100

Most of the suggested improvements were related to increased or improved access (7, 24%).

It would be very useful if this package could be made available permanently.

(BSc Hons Physiotherapy 2003)

"I might have used it at home more if I could have accessed the video, I don't have broadband."

(BSc Hons Occupational Therapy 2003)

6 (21%) students suggested extending the Stroke package.

"I can't believe I'm saying this but maybe we could have more questions per clip."

(BSc Hons Physiotherapy 2003)

"There could have been more questions on the pathology, bring in the neuro-anatomy also."

(MSc pre-registration Physiotherapy 2004)

5 (17%) students commented on the length of the package.

"A shorter version would be helpful."

(BSc Hons Occupational Therapy 2003)

"The Stroke package was very long and I lost concentration."

(BSc Hons Physiotherapy 2003)

Three (10%) Occupational Therapy students suggested specific content relating to Occupational therapy.

"I felt there could be an OT and a Physio package."

(BSc Hons Occupational Therapy 2003)

Quantitative tracking data for the Stroke package

A total of students used the self-study version of the stroke therapy package.

Data was collected on the self-study and the test versions of the package;

Self study version

- the amount of times each student attempted this package
- time spent using this package
- the score achieved at each attempt

The improvement in self-study score was then calculated as the difference between the self-study scores on the students first and final attempts.

Test version

- the test score achieved

The following comparisons were made between the data and tested using Spearman's Rho non-parametric correlation:

- Improvement in self-study score against number of attempts and time spent using the self-study version of the Manual Therapy package.
- Test score against number of attempts and time spent using the self-study version of the Manual Therapy package.

The Stroke test results were not normally distributed following the Kolmogorov – Smirnov test. The test scores for students using the Stroke package ranged from 41% to 100%, the mean test score being 77%. Ranges and means of marks for the self-study scores were as follows:

Section 1 scores ranged from 21% to 92% the mean score being 61%.

Section 2 scores ranged from 16% to 71% the mean score being 49%.

Section 3 scores ranged from 33% to 93% the mean score being 66%.

Section 4 scores ranged from 33% to 79% the mean score being 57%.

Due to the nature of the tracking facilities within Questionmark Perception and the way in which the sections of the Stroke Package were structured it is necessary to consider each of the four sections of the stroke package as separate self-tests. The statistical analysis will therefore be presented in this way.

Stroke Package

Section 1

Table 3.23 Frequency of attempts by students using section 1 of the Stroke self study package.

Number of attempts

		Frequency	Valid Percent
Valid	1 attempt	40	47
	2 attempts	24	28
	3 attempts	11	13
	4 attempts	4	5
	5 attempts	4	5
	6 attempts	1	1
	8 attempts	1	1
	Total	85	100.0

The minimum number of attempts at section 1 of the stroke self study package was one by 16 (47%) students. The maximum number of attempts was 8 (1, 1%). The median number of attempts by the students at section 1 of the stroke self study package was 2.

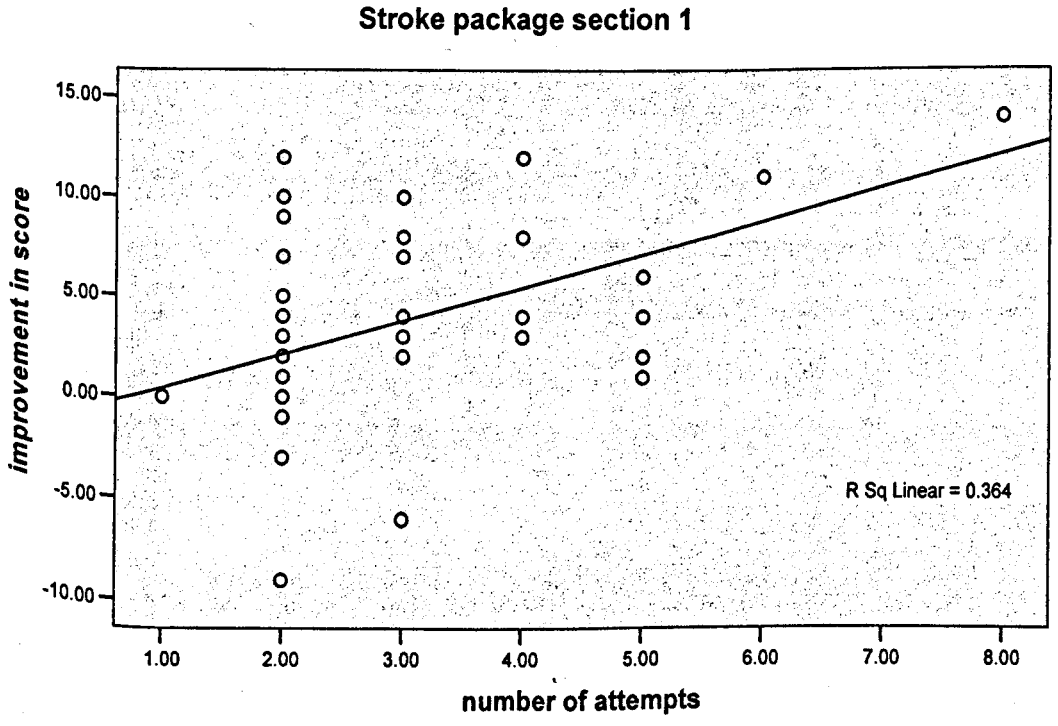
Table 3.24 Times accessed for section 1 of the Stroke self study package.

Time in minutes		Frequency	Valid Percent
Valid	0-20.00	35	41
21 to	30.00	26	31
31 to	40.00	7	8
41 to	50.00	8	9
51 to	60.00	1	1
61 to	70.00	6	7
71 to	80.00	2	2
	Total	85	100.0

The minimum time spent using section 1 of the stroke self study package was 20 minutes. The longest amount of time spent using section 1 of the stroke self study package was 80 minutes (1 hours 20 minutes). The median amount of time spent by students using section 1 of the stroke self study package was 30 minutes.

Fig. 3.2

Scatterplot of improvement in score against number of attempts



From the graph it can be seen that there is a tendency for the amount of improvement to increase as the number of attempts increases. A Spearman's Rho correlation coefficient was used to determine whether there was a significant relationship between improvement in score and the number of attempts for section 1 of the stroke self study package.

Table 3.25 Spearman's Rho correlation for attempts and improvement.

Correlations

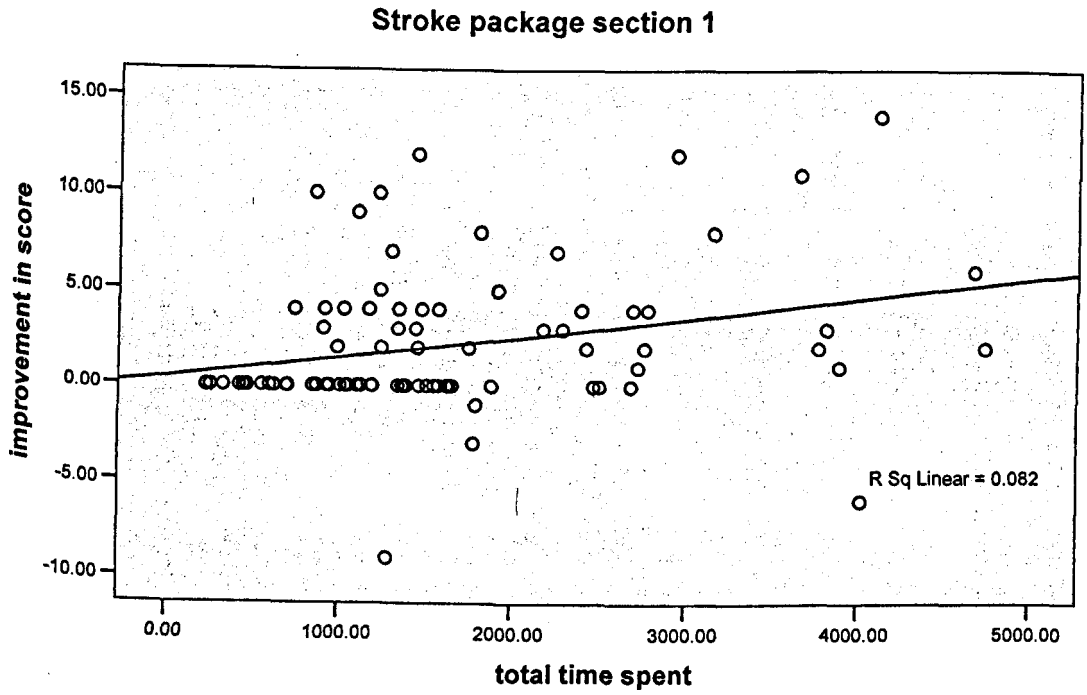
			improvement	number of attempts
Spearman's rho	improvement	Correlation Coefficient	1.000	.745**
		Sig. (2-tailed)	.	.000
		N	85	85
	number of attempts	Correlation Coefficient	.745**	1.000
		Sig. (2-tailed)	.000	.
		N	85	85

**. Correlation is significant at the 0.01 level (2-tailed).

There is a significant relationship between improvement in score and number of attempts using section 1 of the stroke self study package. The strength of the relationship is moderately positive (0.745).

Fig 3.3

Scatterplot of improvement in score against total time spent



From the graph it can be seen that there is a slight tendency for the amount of improvement to increase as the time spent increases. A Spearman's Rho correlation coefficient was used to determine whether there was a significant relationship between improvement in score and the time spent for section 1 of the stroke self study package.

Table 3.26 Spearman's Rho correlation for time spent and improvement.

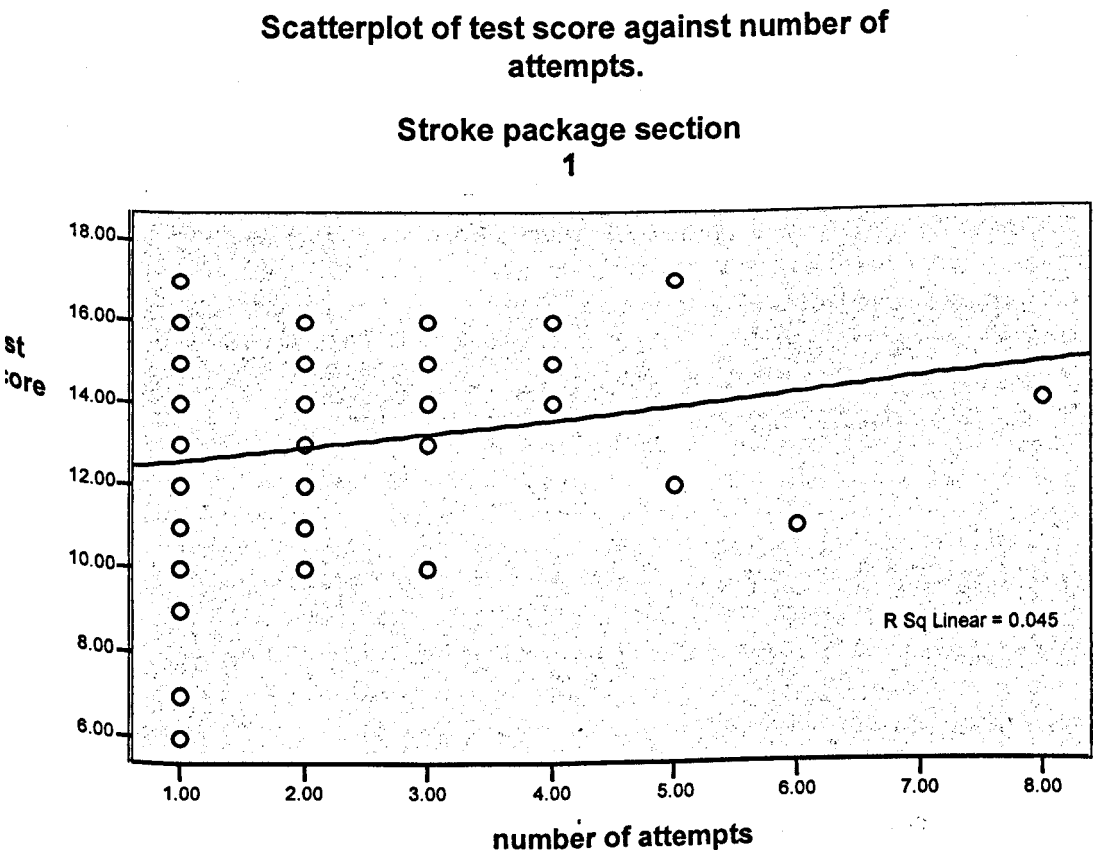
Correlations

			improvement	SUM(times)
Spearman's rho	improvement	Correlation Coefficient	1.000	.336**
		Sig. (2-tailed)	.	.002
		N	85	85
	SUM(times)	Correlation Coefficient	.336**	1.000
		Sig. (2-tailed)	.002	.
		N	85	85

**. Correlation is significant at the 0.01 level (2-tailed).

There is a significant relationship between improvement in score and time spent using section 1 of the stroke self study package. The strength of the relationship is weakly positive (0.336).

Fig. 3.4



From the graph it can be seen that there is a slight tendency for the test score to increase as the number of self-study attempts increases. A Spearman's Rho correlation coefficient was used to determine whether there was a significant relationship between test score and number of self-study attempts for section 1 of the stroke self study package.

Table 3.27 Spearman's Rho correlation for attempts and test score.

Correlations

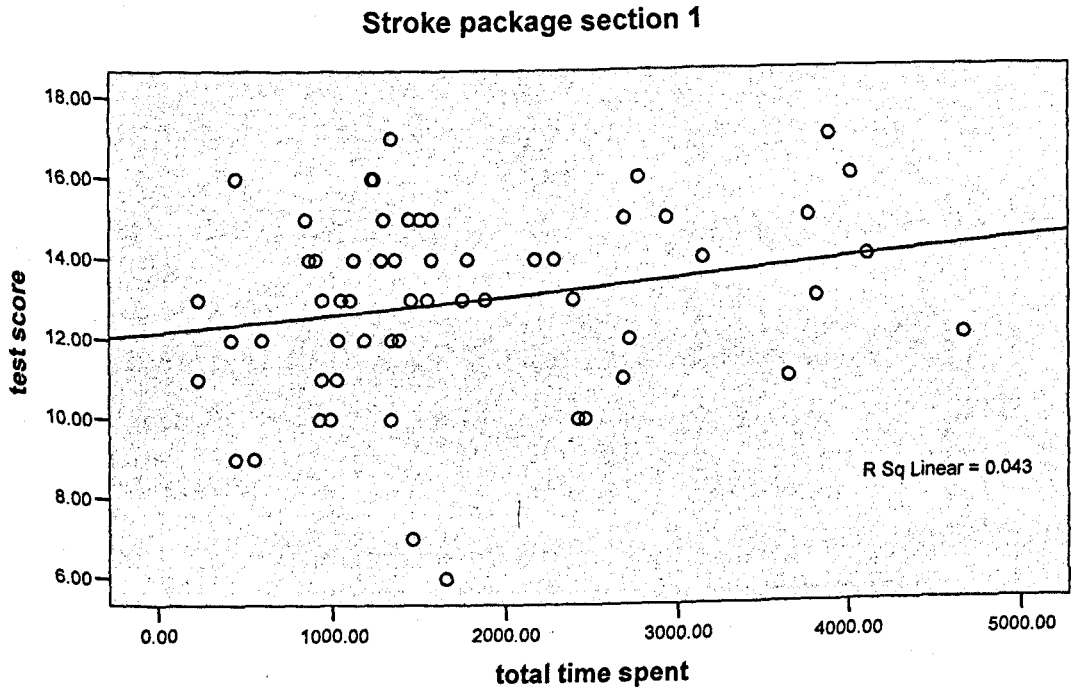
			test score	number of attempts
Spearman's rho	test score	Correlation Coefficient	1.000	.290*
		Sig. (2-tailed)	.	.025
		N	60	60
	number of attempts	Correlation Coefficient	.290*	1.000
		Sig. (2-tailed)	.025	.
		N	60	85

*. Correlation is significant at the 0.05 level (2-tailed).

There is a significant relationship between test score and number of self-study attempts for section 1 of the stroke self study package. The strength of the relationship is weakly positive (0.290).

Fig.3.5

Scatterplot of test score against total time spent



From the graph it can be seen that there is a slight tendency for the test score to increase as the time spent increases. A Spearman's Rho correlation coefficient was used to determine whether there was a significant relationship between test score and time spent using section 1 of the stroke self study package.

Table 3.28 Spearman's Rho correlation for time spent and test score.

Correlations

			SUM(times)	test score
Spearman's rho	SUM(times)	Correlation Coefficient	1.000	.229
		Sig. (2-tailed)	.	.079
		N	85	60
	test score	Correlation Coefficient	.229	1.000
		Sig. (2-tailed)	.079	.
		N	60	60

A significant relationship does not exist between test score and time spent using section 1 of the stroke self study package.

Stroke Package Section 2

Table 3.29 Frequency of attempts by students using section 2 of the stroke self study package.

Number of Attempts		Frequency	Percent
Valid	1 attempt	19	56
	2 attempts	8	24
	3 attempts	4	12
	4 attempts	2	6
	6 attempts	1	3
	Total	34	100.0

The minimum number of attempts at section 2 of the stroke self study package was one by 19 (56%) students. The maximum number of attempts was 6 (1, 3%). The median number of attempts by the students at section 2 of the stroke self study package was 1.

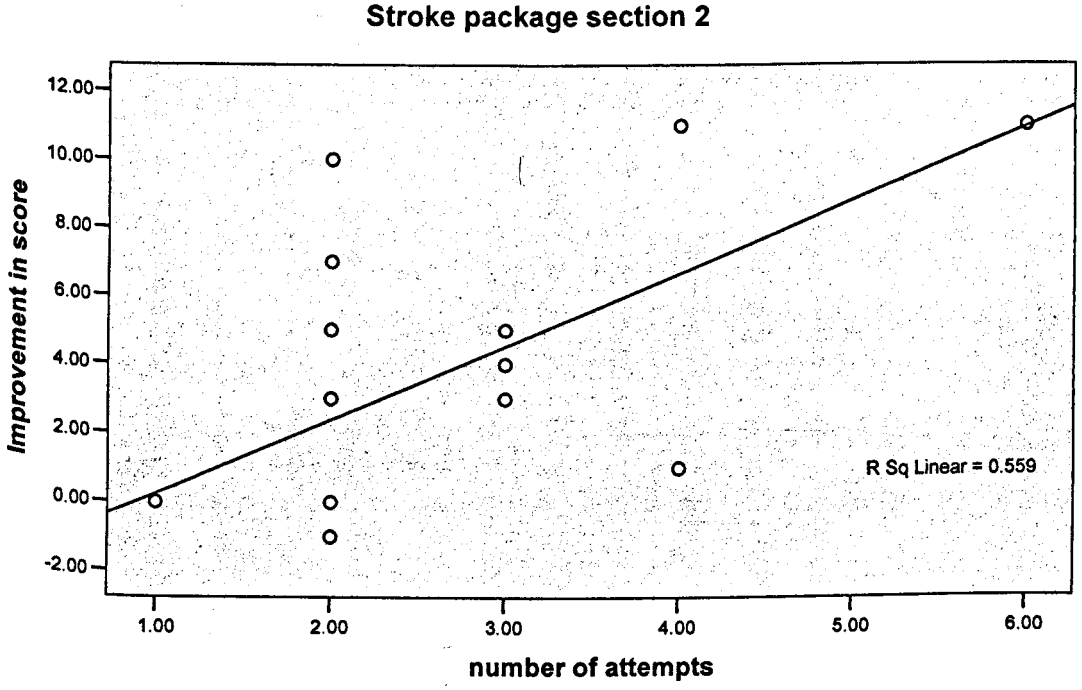
Table 3.30 Time spent by students using section 2 of the Stroke self study package.

Time in minutes		Frequency	Percent
Valid	0-20.00	21	62
21 to	30.00	8	24
31 to	40.00	4	12
71 to	80.00	1	3
	Total	34	100.0

The minimum time spent using section 2 of the stroke self study package was 3 minutes. The longest amount of time spent using section 2 of the stroke self study package was 75 minutes (1 hours 15 minutes). The median amount of time spent by students using section 2 of the stroke self study package was 17 minutes.

Fig. 3.6

Scatterplot of improvement in score against number of attempts



From the graph it can be seen that there is a tendency for improvement in score to increase as the number of attempts increases. A Spearman's Rho correlation coefficient was used to determine whether there was a significant relationship between test score and time spent using section 2 of the stroke self study package.

Table 3.31 Spearman's Rho correlation for attempts and improvement.

Correlations

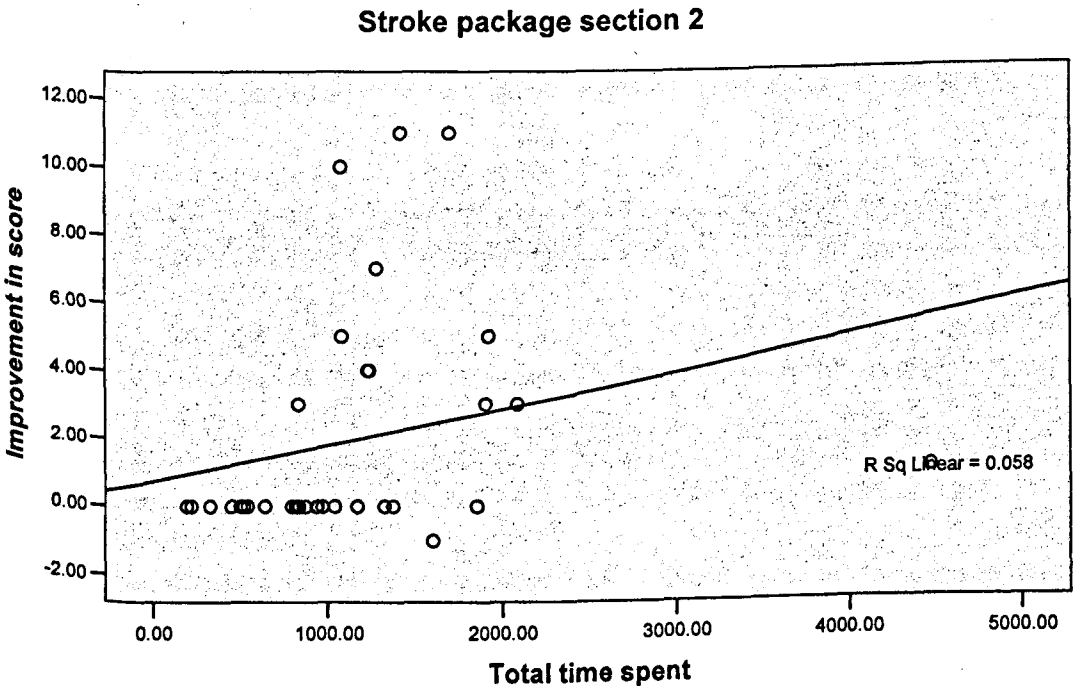
			improvement	number of attempts
Spearman's rho	improvement	Correlation Coefficient	1.000	.780**
		Sig. (2-tailed)	.	.000
		N	34	34
	number of attempts	Correlation Coefficient	.780**	1.000
		Sig. (2-tailed)	.000	.
		N	34	34

**. Correlation is significant at the 0.01 level (2-tailed).

There is a significant relationship between improvement in self-study score and number of self-study attempts for section 2 of the stroke self study package. The strength of the relationship is moderately positive (0.780).

Fig. 3.7

Scatterplot of improvement in score against total time spent



From the graph it can be seen that there is a slight tendency for improvement in score to increase as time spent increases. A Spearman's Rho correlation coefficient was used to determine whether there was a significant relationship between improvement in score and time spent using section 2 of the stroke self study package.

Table 3.32 Spearman's Rho correlation for time spent and improvement.

Correlations

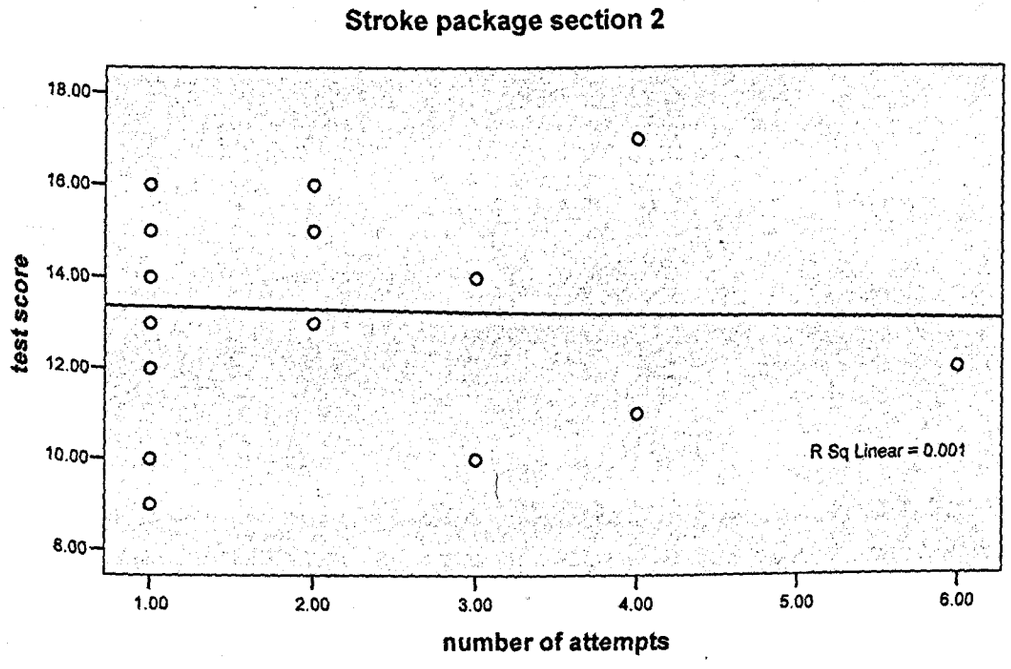
			improvement	SUM(times)
Spearman's rho	improvement	Correlation Coefficient	1.000	.500**
		Sig. (2-tailed)	.	.003
		N	34	34
	SUM(times)	Correlation Coefficient	.500**	1.000
		Sig. (2-tailed)	.003	.
		N	34	34

**. Correlation is significant at the 0.01 level (2-tailed).

There is a significant relationship between improvement in self-study score and time spent for section 2 of the stroke self study package. The strength of the relationship is moderately positive (0.500).

Fig.3.8

Scatterplot of test score against number of attempts



From the graph there does not appear to be a relationship between test score and number of self-study attempts. A Spearman's Rho correlation coefficient was used to determine whether there was a significant relationship between test score and number of attempts for section 2 of the stroke self study package.

Table 3.33 Spearman's Rho correlation for attempts and test score.

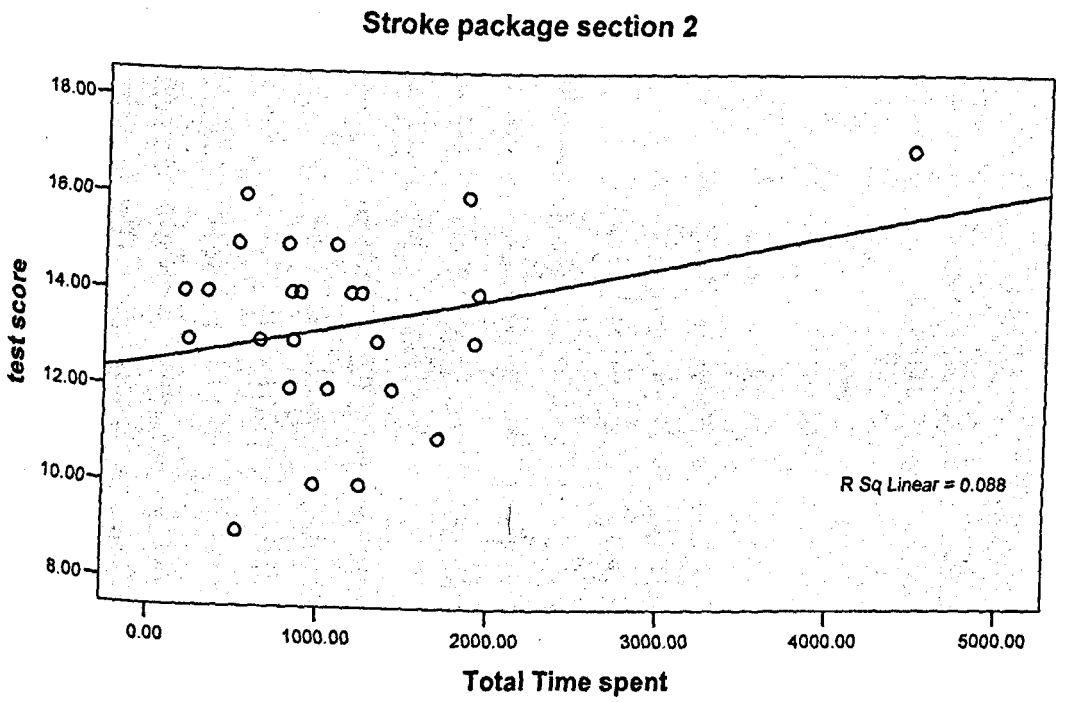
Correlations

			number of attempts	test score
Spearman's rho	number of attempts	Correlation Coefficient	1.000	.019
		Sig. (2-tailed)	.	.929
		N	34	25
	test score	Correlation Coefficient	.019	1.000
		Sig. (2-tailed)	.929	.
		N	25	25

A significant relationship does not exist between test score and number of attempts for section 2 of the stroke self study package.

Fig. 3.9

Scatterplot of test score against total time spent



From the graph there does not appear to be a relationship between test score and time spent. A Spearman's Rho correlation coefficient was used to determine whether there was a significant relationship between test score and time spent using section 2 of the stroke self study package.

Table 3.34 Spearman's Rho correlation for time spent and test score.

Correlations

			test score	SUM(times)
Spearman's rho	test score	Correlation Coefficient	1.000	-.002
		Sig. (2-tailed)	.	.993
		N	25	25
	SUM(times)	Correlation Coefficient	-.002	1.000
		Sig. (2-tailed)	.993	.
		N	25	34

A significant relationship does not exist between test score and number of attempts for section 2 of the stroke self study package.

Stroke Package Section 3

Table 3.35 Frequency of attempts by students using section 3 of the stroke self study package.

Number of attempts		Frequency	Percent
Valid	1 attempt	16	55
	2 attempts	5	17
	3 attempts	7	24
	4 attempts	1	3
	Total	29	100.0

The minimum number of attempts at section 2 of the stroke self study package was one by 16 (55%) students. The maximum number of attempts was 4 (1, 3%). The median number of attempts by the students at section 3 of the stroke self study package was 1.

Table 3.36 Time spent by students using section 3 of the stroke self study package.

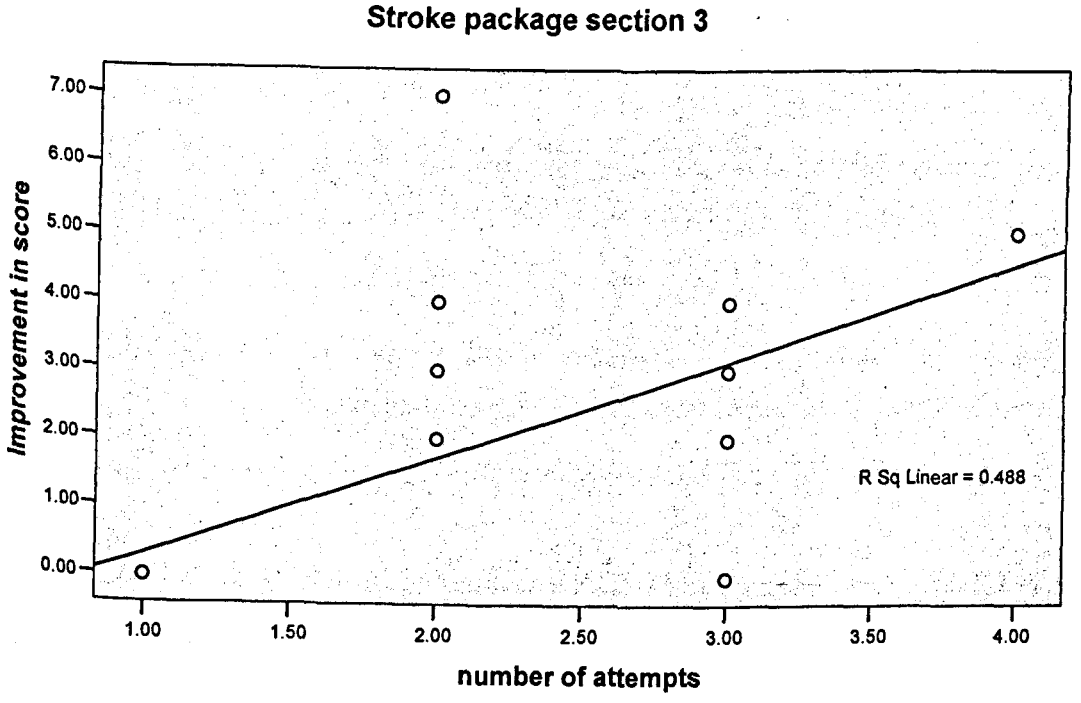
Time in minutes		Frequency	Percent
Valid	0-20.00	21	72
21 to	30.00	3	10
31 to	40.00	1	3
41 to	50.00	2	7
over	100	2	7
	Total	29	100.0

The minimum time spent using section 3 of the stroke self study package was 5 minutes. The longest amount of time spent using section 3 of the stroke self study

package was 222 minutes (2 hours 42 minutes). The median amount of time spent by students using section 1 of the stroke self study package was 17 minutes.

Fig. 3.10

Scatterplot of improvement against number of attempts



From the graph it can be seen that there is a slight tendency for improvement in score to increase as number of attempts increases. A Spearman's Rho correlation coefficient was used to determine whether there was a significant relationship between improvement in score and number of attempts using section 3 of the stroke self study package.

Table 3.37 Spearman's Rho correlation for time spent and test score.

Correlations

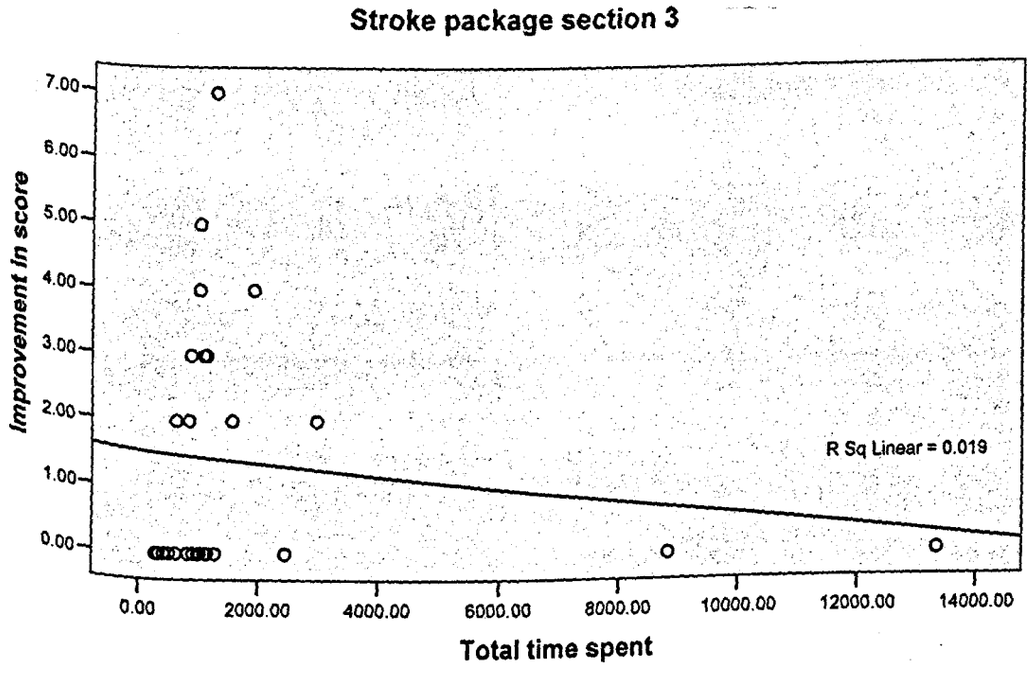
			number of attempts	improvement
Spearman's rho	number of attempts	Correlation Coefficient	1.000	.830**
		Sig. (2-tailed)	.	.000
		N	29	29
	improvement	Correlation Coefficient	.830**	1.000
		Sig. (2-tailed)	.000	.
		N	29	29

**. Correlation is significant at the 0.01 level (2-tailed).

There is a significant relationship between improvement in self-study score and number of attempts for section 3 of the stroke self study package. The strength of the relationship is strongly positive (0.830).

Fig.3.11

Scatterplot of improvement against time spent



From the graph there does not appear to be a relationship between improvement in score and time spent. A Spearman's Rho correlation coefficient was used to determine whether there was a significant relationship between improvement in score and time spent using section 3 of the stroke self study package.

Table 3.38 Spearman's Rho correlation for time spent and improvement.

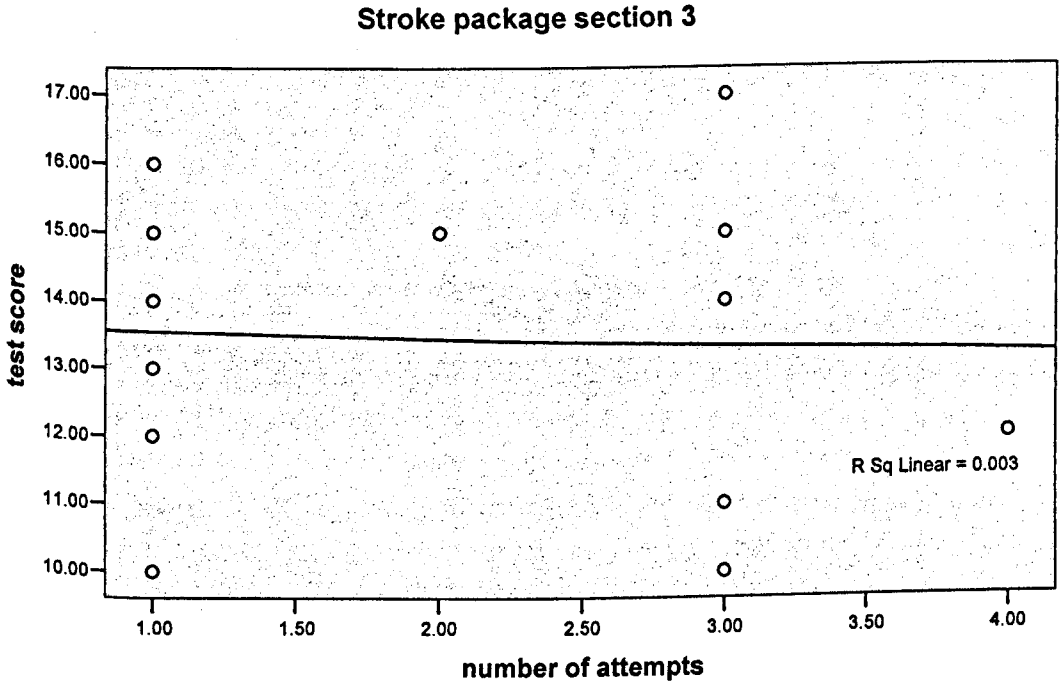
Correlations

			improvement	SUM(times)
Spearman's rho	improvement	Correlation Coefficient	1.000	.243
		Sig. (2-tailed)	.	.205
		N	29	29
	SUM(times)	Correlation Coefficient	.243	1.000
		Sig. (2-tailed)	.205	.
		N	29	29

A significant relationship does not exist between improvement in score and time spent for section 3 of the stroke self study package.

Fig.3.12

Scatterplot of test score against number of attempts



From the graph there does not appear to be a relationship between test score and number of attempts. A Spearman's Rho correlation coefficient was used to determine whether there was a significant relationship between test score and number of attempts using section 3 of the stroke self study package.

Table 3.39 Spearman's Rho correlation for attempts and test score.

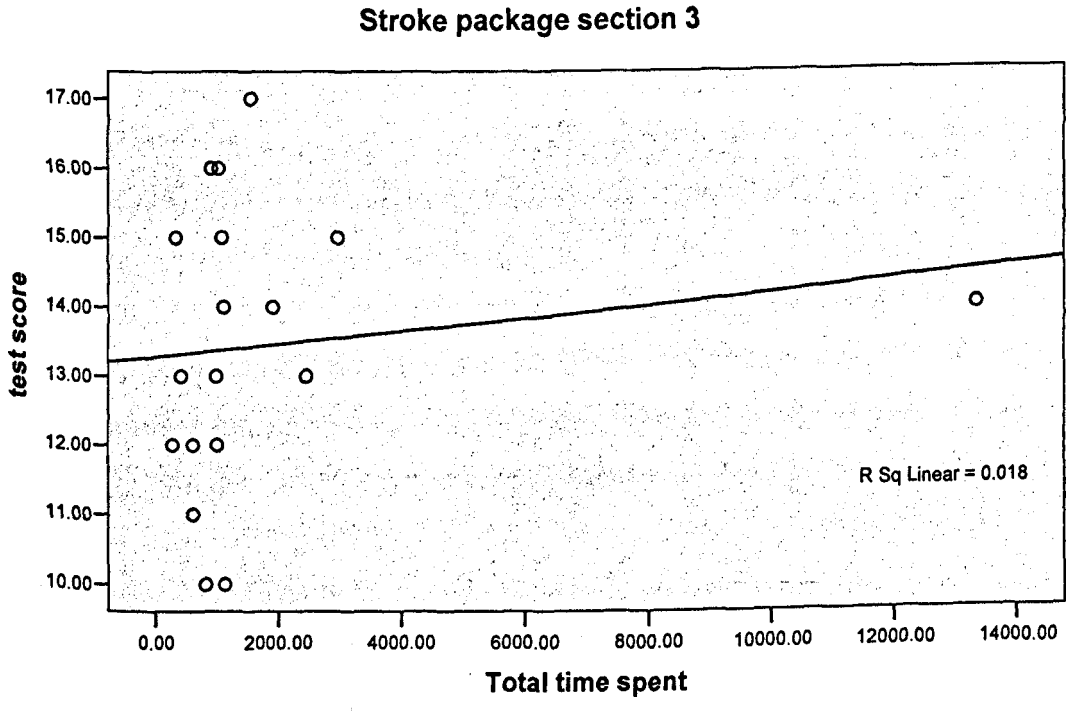
Correlations

			number of attempts	test score
Spearman's rho	number of attempts	Correlation Coefficient	1.000	-.042
		Sig. (2-tailed)	.	.868
		N	29	18
	test score	Correlation Coefficient	-.042	1.000
		Sig. (2-tailed)	.868	.
		N	18	18

A significant relationship does not exist between test score and number of attempts for section 3 of the stroke self study package.

Fig.3.13

Scatterplot of test score against total time spent



From the graph there does not appear to be a relationship between test score and time spent. A Spearman's Rho correlation coefficient was used to determine whether there was a significant relationship between test score and time spent using section 3 of the stroke self study package.

Table 3.40 Spearman's Rho correlation for time spent and test score.

Correlations

			test score	SUM(times)
Spearman's rho	test score	Correlation Coefficient	1.000	.322
		Sig. (2-tailed)	.	.193
		N	18	18
	SUM(times)	Correlation Coefficient	.322	1.000
		Sig. (2-tailed)	.193	.
		N	18	29

A significant relationship does not exist between test score and time spent for section 3 of the stroke self study package.

Stroke Package Section 4

Table 3.41 Frequency of attempts by students using section 4 of the Stroke self-study package.

Number of Attempts		Frequency	Percent
Valid	1 attempt	13	50
	2 attempts	10	39
	3 attempts	2	8
	4 attempts	1	4
	Total	26	100.0

The minimum number of attempts at section 4 of the stroke self study package was one by 13 (50%) students. The maximum number of attempts was 4 (1, 4%). The median number of attempts by the students at section 4 of the stroke self study package was 2.

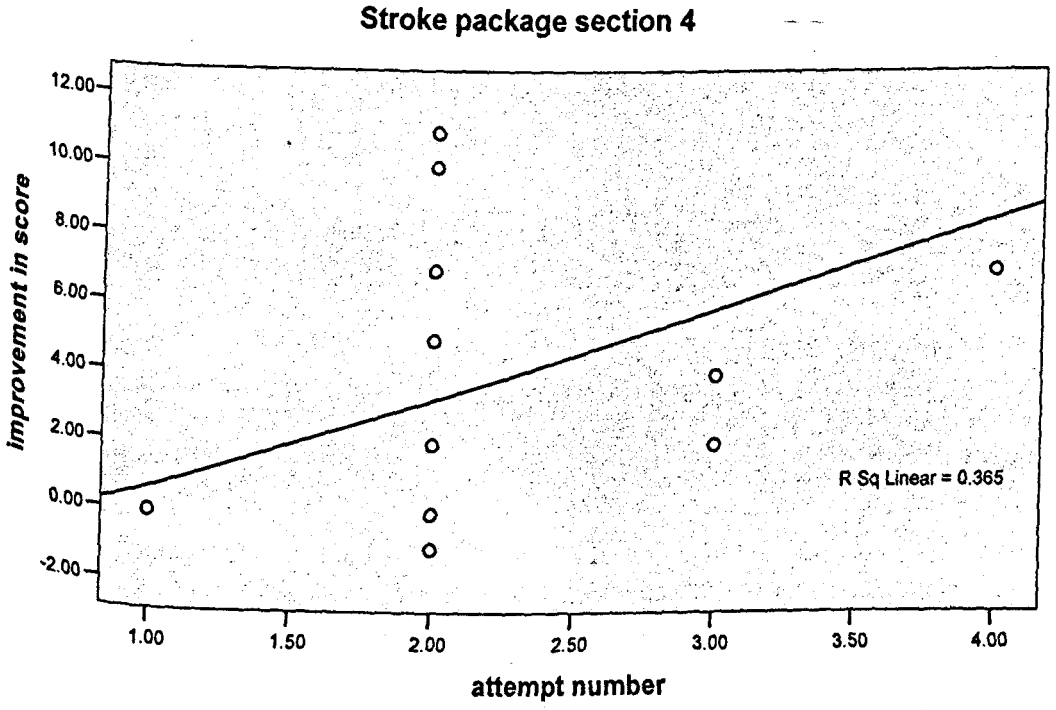
Table 3.42 Time spent by students using section 4 of the Stroke self-study package.

Time in minutes		Frequency	Percent
Valid	0-20.00	19	73
21 to	30.00	7	27
	Total	26	100.0

The minimum time spent using section 4 of the stroke self study package was 4 minutes. The longest amount of time spent using section 4 of the stroke self study package was 30 minutes. The median amount of time spent by students using section 4 of the stroke self study package was 15 minutes.

Fig.3.14

Scatterplot of improvement against number of attempts



From the graph it can be seen that there is a slight tendency for improvement in score to increase as number of attempts increases. A Spearman's Rho correlation coefficient

was used to determine whether there was a significant relationship between improvement in score and number of attempts using section 4 of the stroke self study package.

Table 3.43 Spearman's Rho correlation for attempts and improvement.

Correlations

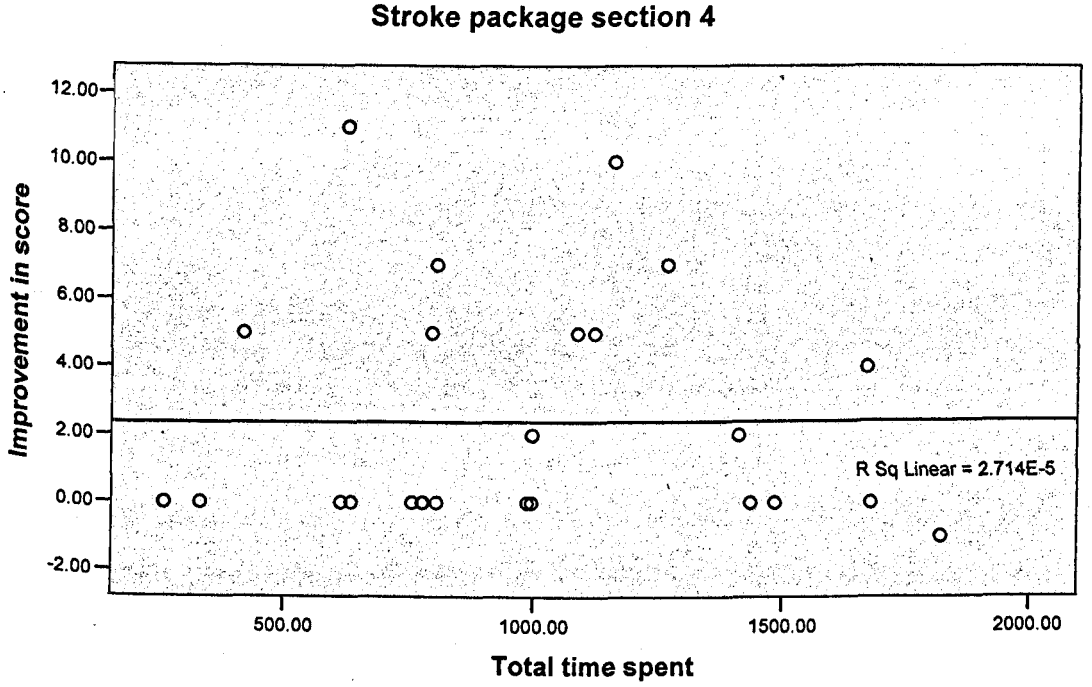
			attempt number	improvement
Spearman's rho	attempt number	Correlation Coefficient	1.000	.715**
		Sig. (2-tailed)	.	.000
		N	26	26
	improvement	Correlation Coefficient	.715**	1.000
		Sig. (2-tailed)	.000	.
		N	26	26

**. Correlation is significant at the 0.01 level (2-tailed).

There is a significant relationship between improvement in self-study score and number of attempts for section 4 of the stroke self study package. The strength of the relationship is moderately positive (0.715).

Fig.3.15

Scatterplot of improvement against time spent



From the graph there does not appear to be a relationship between improvement in score and time spent. A Spearman's Rho correlation coefficient was used to determine whether there was a significant relationship between improvement in score and time spent using section 4 of the stroke self study package.

Table 3.44 Spearman's Rho correlation for time spent and improvement.

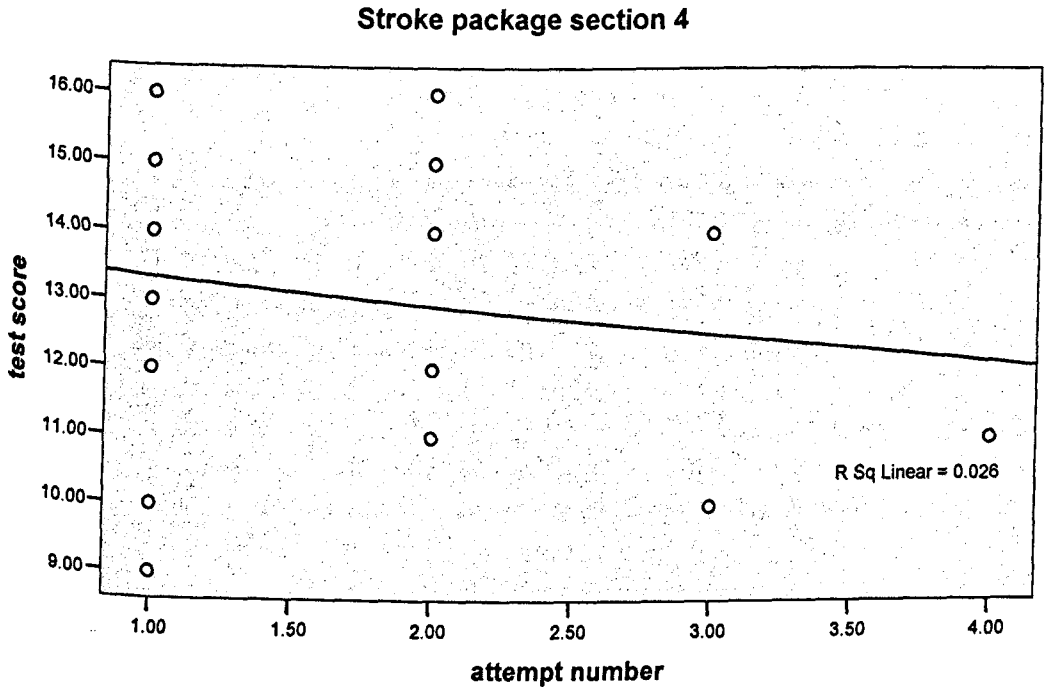
Correlations

			improvement	SUM(times)
Spearman's rho	improvement	Correlation Coefficient	1.000	.054
		Sig. (2-tailed)	.	.793
		N	26	26
	SUM(times)	Correlation Coefficient	.054	1.000
		Sig. (2-tailed)	.793	.
		N	26	26

A significant relationship does not exist between improvement in score and time spent for section 4 of the stroke self study package.

Fig. 3.16

Scatterplot of test score against number of attempts



From the graph there does not appear to be a relationship between test score and number of attempts. A Spearman's Rho correlation coefficient was used to determine whether there was a significant relationship between test score and number of attempts for section 4 of the stroke self study package.

Table 3.45 Spearman's Rho correlation for attempts and test score.

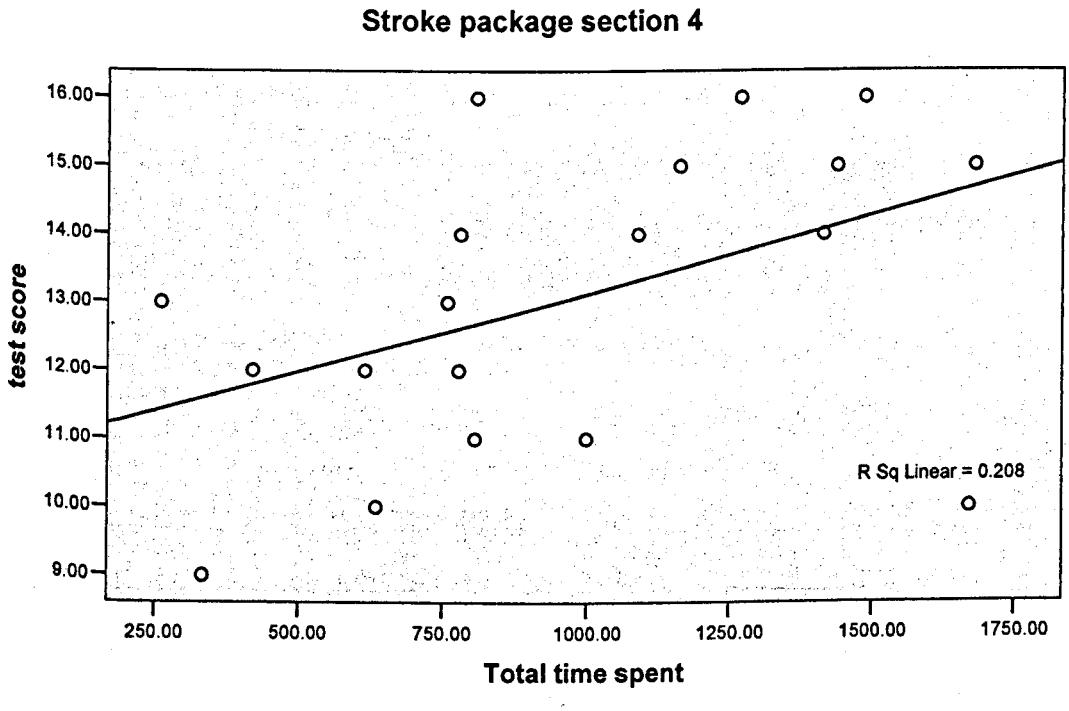
Correlations

			attempt number	test score
Spearman's rho	attempt number	Correlation Coefficient	1.000	-.094
		Sig. (2-tailed)	.	.702
		N	26	19
	test score	Correlation Coefficient	-.094	1.000
		Sig. (2-tailed)	.702	.
		N	19	19

A significant relationship does not exist between test score and number of attempts for section 4 of the stroke self study package.

Fig. 3.17

Scatterplot of test score against total time spent



From the graph it can be seen that there is a slight tendency for test score to increase as time spent increases. A Spearman's Rho correlation coefficient was used to determine whether there was a significant relationship between test score and time spent for section 4 of the stroke self study package.

Table 3.46 Spearman's Rho correlation for attempts and test score.

Correlations

			test score	SUM(times)
Spearman's rho	test score	Correlation Coefficient	1.000	.517*
		Sig. (2-tailed)	.	.024
		N	19	19
	SUM(times)	Correlation Coefficient	.517*	1.000
		Sig. (2-tailed)	.024	.
		N	19	26

*. Correlation is significant at the 0.05 level (2-tailed).

There is a significant relationship between test score and time spent for section 4 of the stroke self study package. The strength of the relationship is moderately positive (0.517).

Summary of Stroke package findings from tracking data

The following table summarises the ranges and average attempts and time spent for each section of the Stroke package.

Table 3.47 Summary of students' access of the Stroke package

	Stroke package section			
	Section 1 (n= 85)	Section2 (n= 34)	Section 3 (n= 29)	Section 4 (n= 26)
Range of attempts	1-8	1-6	1-4	1-4
Average attempts	2	1	1	2
Range of time spent (mins)	20-80	3-75	5-222	4-30
Average time spent (mins)	30	17	17	15

The number of attempts ranges from 1 to 8. The amount of time spent using each section ranges from 3 to 222 minutes. Students most commonly accessed the first section of the Stroke package.

The following table summarises the significant findings for comparison of students' number of attempts and time spent using the self-study packages with their improvements in self-study score and test score.

Table 3.48 Significant results for the Stroke package

Variables compared	Stroke 1 (n=85)	Stroke 2 (n=34)	Stroke 3 (n=29)	Stroke 4 (n=26)
Improvement in score with number of attempts	0.745	0.780	0.830	0.715
Improvement in score with time spent	0.336	0.500	N/S	N/S
Test score with number of attempts	0.290	N/S	N/S	N/S
Test score with time spent	N/S	N/S	N/S	0.517

(N/S = not significant)

Half of the comparisons for the Stroke package were significant. All correlations found were positive. The results show strong positive correlations between improvement in score with number of attempts for all sections of the Stroke package.

Section 4 Comparative results for the Movement Analysis, Manual Therapy and Stroke Packages

This section presents comparative results for the evaluation questionnaire for the movement analysis package, manual therapy package and stroke package. A comparison of students' attitudes towards computers, the features of the packages and preferred delivery methods is presented in the first part followed by a statistical analysis of significant differences between students' opinions in relation to each package. In order to allow statistical comparison between packages (between subject analysis) one evaluation per group contributed to the comparison. Thus as groups evaluating more than one package were the only cohorts to evaluate the manual therapy package these evaluations were included. This ensured a mathematically sound comparison between the packages. Packages were compared for statistical differences using a Kruskall – Wallis test at the 0.05 level of significance. In order to analyse where the main difference lay between packages a post hoc Mann-Whitney U test was carried out and a Bonferoni correction determined the level of significance to be $p = 0.016$.

Open responses for each package are also compared. The final section presents information regarding use of the community groups associated with the three packages.

The following table summarises the group distribution and number of students who evaluated each package and those evaluations chosen to contribute to the statistical analysis.

Table 4.1. Groups and number of students evaluating each package.

Course Group	Movement Analysis Package	Manual Therapy Package	Stroke Package
BSc Hons PT 2002 intake	20		
BSc Hons PT 2003 intake	29 (removed from statistical comparison)	20	43 (removed from statistical comparison)
BSc Hons OT 2002 intake	25		
BSc Hons OT 2003 intake			34
MSc pre-reg. PT 2002 intake	16		
MSc pre-reg. PT 2003 intake	22		
MSc pre-reg. PT 2004 intake		19	18 (removed from statistical comparison)
BSc Hons SES 2003 intake	12		
Number of students included in comparative analysis	95	39	34

The following table shows the proportion of students' agreement and disagreement with statements about computers for each package.

Table 4.2 Comparison between packages of attitudes towards computers.

Statements about computers	%Strongly Disagree			%Disagree			%Agree			%Strongly Agree		
	MAP	MT	SP	MAP	MT	SP	MAP	MT	SP	MAP	MT	SP
Anyone can use a computer.	2	0	0	4	3	3	58	59	62	35	39	35
I find a computer difficult to use.	35	21	29	54	69	62	9	8	6	2	3	3
Computers isolate you from other people.	23	10	12	61	41	62	16	46	24	0	3	3
Computer literacy will make me more employable.	0	0	0	1	3	0	56	49	53	43	49	47
I am afraid of looking silly if making a mistake while using the computer.	32	13	18	60	78	56	8	8	27	0	0	0

MAP = Movement Analysis Package

MT = Manual Therapy Package

SP = Stroke Package

Most students using each of the three packages tended to disagree with negative statements about computers and agree with positive statements about computers. The statements:

"Computers isolate you from other people." ($p = 0.001$)

"I am afraid of looking silly if I make a mistake while using the computer." ($p = 0.017$)

Elicited significantly different responses between the three packages.

The statement:

"Computers isolate you from other people." ($p = 0.000$)

Elicited significantly different responses between students evaluating the Movement Analysis package and the Manual Therapy package. A greater proportion of students evaluating the Movement Analysis package tended to agree or strongly agree with this statement than those evaluating the Manual Therapy package.

The statement:

"I am afraid of looking silly if I make a mistake while using the computer."

($p = 0.012$)

Elicited significantly different responses between students evaluating the Movement Analysis package and the Stroke package. A greater proportion of students evaluating the Movement Analysis package tended to strongly disagree with this statement than those evaluating the Stroke package.

There were no significant differences found between students evaluating the Manual Therapy package and the Stroke package for these statements.

The following table shows proportions of students' confidence with computer based activities for the three packages.

Table 4.3 Comparison between packages of confidence with computers.

Computer based activity	%No confidence			%Little confidence			%Some confidence			%Confident			%Very Confident		
	MAP	MT	SP	MAP	MT	SP	MAP	MT	SP	MAP	MT	SP	MAP	MT	SP
Web based	2	0	0	2	3	0	16	5	3	43	70	68	37	22	29
Navigating materials on-line	3	0	0	6	3	3	23	16	13	37	65	55	31	16	29
Reading on-line	2	0	0	5	3	0	18	8	19	46	78	65	28	11	16
Using multimedia	2	0	0	11	3	0	37	19	19	37	68	71	14	11	10
Independent Study	1	0	3	3	3	0	22	3	0	42	70	74	32	24	23
Self study	1	3	3	1	3	0	20	14	10	47	58	71	31	22	16

MAP = Movement Analysis Package

MT = Manual Therapy Package

SP = Stroke Package

Students evaluating all three packages were mostly confident in all types of computer based activities.

There was a significant difference between students evaluating the three packages regarding their level of confidence with using multimedia ($p = 0.012$). The greatest difference appears to lie between students evaluating the Movement Analysis and Stroke packages. This difference was no longer significant when each of the packages was compared with each other.

The following table shows proportions of students' agreement and disagreement with statements about features of the three packages.

Table 4.4 Comparison between packages of agreement / disagreement with statements about package features.

Common Statements about the packages	%Strongly Disagree			%Disagree			%Agree			%Strongly Agree		
	MAP	MT	SP	MAP	MT	SP	MAP	MT	SP	MAP	MT	SP
It is clear what options are open to you at each stage.	1	0	0	4	10	3	77	77	77	18	13	21
It is easy to navigate to where you want to go.	1	3	0	12	0	6	70	84	65	17	13	29
There are clear instructions on how to use the package.	0	0	0	6	10	0	80	80	71	14	10	29
There are consistent procedures throughout the package.	0	3	0	4	15	0	77	64	74	19	18	27
The videos are worthwhile and supported my learning.	0	3	0	8	0	0	66	56	50	27	41	50
The information on screen is easy to read.	1	0	0	4	0	0	59	69	59	35	31	41
The presentation is informative.	0	0	0	2	3	3	75	71	53	23	26	44
The package is enjoyable to use.	1	0	0	9	23	6	79	67	77	11	10	18
It helps you to learn about the topic.	0	0	0	1	8	0	59	69	53	40	23	47
It fits well with the rest of my course material.	1	0	0	3	5	6	54	69	65	42	26	29
The time spent using the package is well worth it.	2	0	0	8	15	3	65	74	82	25	10	15
It would help me to revise the subject.	0	0	0	4	8	0	47	64	74	48	28	27

MAP = Movement Analysis Package

MT = Manual Therapy Package

SP = Stroke Package

Students evaluating all three packages mostly agreed with common positive statements about the packages.

The following statements elicited significantly different responses from students evaluating the three packages:

" There are clear instructions on how to use the package." ($p = 0.018$)

"The videos are worthwhile and supported my learning." ($p = 0.015$)

" It helps you learn about the topic." ($p = 0.032$)

"It would help me to revise the subject." ($p = 0.039$)

The statement:

" There are clear instructions on how to use the package." ($p = 0.010$)

Elicited a significant difference between students evaluating the Manual Therapy and Stroke packages. A greater proportion of students evaluating the Manual Therapy package disagreed with this statement.

The statement:

"The videos are worthwhile and supported my learning." ($p = 0.006$)

Elicited a significant difference between students evaluating the Movement Analysis package and the Stroke package. A greater proportion of students evaluating the Stroke package strongly agreed with this statement.

No significant differences were found when each of the packages were compared with each other for these statements:

" It helps you learn about the topic."

"It would help me to revise the subject."

The following table shows the proportion of students ranked preferences for different methods of delivery for learning about movement analysis, manual therapy and stroke.

Table 4.5 Comparison between packages of preferred delivery methods.

	%5th			%4th			%3rd			%2nd			%1st		
	MAP	MT	SP	MAP	MT	SP	MAP	MT	SP	MAP	MT	SP	MAP	MT	SP
Web based	21	11	10	21	22	16	12	30	23	27	22	26	18	16	26
CD ROM	15	8	16	30	30	26	18	24	13	24	30	23	12	8	23
Paper based	33	62	45	21	22	13	33	11	19	3	5	13	9	0	10
Face to Face	3	19	23	27	27	26	24	16	13	24	32	29	21	5	10
Practical class	27	0	7	0	0	19	12	19	32	21	11	10	39	70	32

MAP = Movement Analysis Package

MT = Manual Therapy Package

SP = Stroke Package

The favoured delivery method for students evaluating all three packages appears to be the practical class. Students evaluating all packages on average rated web-based learning third.

There was a significant difference between students ranking of paper – based delivery ($p = 0.021$) and practical classes ($p = 0.001$).

There was a significant difference between students evaluating the Manual Therapy and Movement Analysis packages regarding both practical classes ($p = 0.004$) and paper based delivery ($p = 0.007$).

There was a significant difference between students evaluating the Manual Therapy and Stroke packages regarding ranking of practical classes ($p = 0.000$).

A much larger proportion of students evaluating the Manual Therapy package ranked practical classes as their most favoured method of delivery and paper based delivery as their least favoured.

Open response questions

The open responses for each package have been summarised in the following tables

Table 4.6 Positive and negative responses for each question per package.

Question	Movement Analysis (*n*=425)		Manual Therapy (*n*=139)		Stroke (*n*=349)		Total (*n*=913)
	positive	negative	positive	negative	positive	negative	
General knowledge	96 (23%)	28 (7%)	32 (23%)	8 (6%)	74 (21%)	16 (5%)	254 (28%)
Understanding	70 (16%)	23 (5%)	29 (21%)	7 (5%)	48 (14%)	13 (4%)	190 (21%)
Application	74 (17%)	5 (1%)	20 (14%)	5 (4%)	57 (16%)	9 (3%)	170 (19%)
Like or not	121 (28%)	8 (2%)	36 (26%)	2 (2%)	117 (34%)	15 (4%)	299 (33%)
Total	361 (85%)	64 (15%)	117 (84%)	22 (16%)	296 (85%)	53 (15%)	913 (100%)

A total of 913 open responses were elicited from the students for questions that were common to all three packages. Of these responses 774 (85%) were positive and 139 (15%) were equivocal or negative.

The total number of responses to these questions elicited by the movement analysis package was 425, the manual therapy package; 139 and the stroke package; 349. All packages elicited similar proportions of positive and equivocal or negative responses. The following question elicited the greatest proportion of responses (299, 33%).

"Did you like the package or not, please give up to 3 reasons for your answer."

A question by question analysis of comments relating to the response themes for each package is described below.

Table 4.7 Positive comments about the effect of each package on general knowledge.

Comment Theme	Package			
	Movement Analysis (*n*=124)	Manual Therapy (*n*=40)	Stroke (*n*=90)	Total (*n*=254)
General	9 (7%)	9 (23%)	17 (19%)	35 (14%)
Reinforces / revises knowledge	20 (16%)	5 (13%)	6 (7%)	31 (12%)
Understanding / Using terminology	9 (7%)	0	3 (3%)	12 (5%)
Relating Knowledge	19 (15%)	0	1(1%)	20 (8%)
Self assessment / feedback	7 (6%)	10 (25%)	7 (8%)	24 (9%)
Video / Audio	14 (11%)	4 (10%)	24 (27%)	42 (17%)
Clarification	5 (4%)	0	1 (1%)	6 (2%)
Alternative method of study	1 (1%)	0	0	1 (0%)
Relevance to clinical / work-based activities	12 (10%)	4 (10%)	6 (7%)	22 (9%)
Ease of Use/ Access	0	0	9 (10%)	9 (4%)
Total comments per package	96 (77%)	32 (80%)	74 (82%)	202 (80%)

Overall, 202 (80%) of students' comments about how the packages affected their general knowledge were positive. Each package elicited a similar proportion of positive responses to this question (M.A.P.77% M.T. 80% and S.P.82%).

Reinforcement and revision of knowledge was the most common theme identified by students as positively affecting their general knowledge for the movement analysis package (20,16%).

Students responding to this question in relation to the manual therapy package mainly referred to self-assessment and feedback (10, 25%) as positively affecting their general knowledge.

Students responding to this question in relation to the stroke package mainly referred to the video clips (24, 27%) as positively affecting their general knowledge.

Table 4.8 Equivocal / negative comments about the effect of each package on general knowledge.

Comment Theme	Package			
	Movement Analysis (*n*=124)	Manual Therapy (*n*=40)	Stroke (*n*=90)	Total (*n*=254)
General	10 (8%)	6 (15%)	10 (11%)	26 (10%)
Lack of use	10 (8%)	0	1(1%)	11 (4%)
Not stand alone package	5 (4%)	2 (5%)	4 (4%)	11 (4%)
Prefer book / other method of study	2 (2%)	0	0	2(1%)
Technical problems	1 (1%)	0	0	1 (0%)
Related to Physiotherapy	0	0	1(1%)	1(0%)
Total Comments per package	28 (23%)	8 (20%)	16 (18%)	52 (20%)

Overall 52 (20%) of comments were equivocal or negative about the effects of the packages on general knowledge. There was a similar proportion of equivocal and negative comments across the packages. Most of these comments were general (27, 11%).

Students evaluating the movement analysis package also made reference to lack of use having an equivocal or negative effect on their general knowledge.

Table 4.9 Positive comments about the effect of each package on understanding.

Comment Theme	Package			
	Movement Analysis (*n*=93)	Manual Therapy (*n*=36)	Stroke (*n*=61)	Total (*n*=190)
General	9(10%)	6 (17%)	4 (7%)	19 (10%)
Reinforcement / revision of knowledge	11 (12%)	5 (14%)	4 (7%)	20 (11%)
Understanding / Using terminology	4 (4%)	0	1 (2%)	5 (3%)
Relating Knowledge	23 (25%)	0	5 (8%)	28 (15%)
Self assessment / feedback	1 (1%)	8 (22%)	4 (7%)	13 (7%)
Video / Audio	16 (17%)	5 (14%)	23(38%)	44(23%)
Clarification	1 (1%)	4 (11%)	2 (3%)	7 (4%)
Alternative method of study	1 (1%)	1 (3%)	0	2 (1%)
Relevance to practical/ clinical / work-based activities	4 (4%)	0	5 (8%)	9 (5%)
Total Comments per package	70 (75%)	29 (81%)	48 (79%)	147 (77%)

Overall, 147 (77%) of students' positive open comments to these common questions were about how the packages affected their understanding. The manual therapy package elicited the greatest proportion of positive responses to this question (29, 81%).

Relating knowledge was the most common theme identified by students as positively affecting their understanding for the movement analysis package (23,25%).

Students responding to this question in relation to the manual therapy package mainly referred to self-assessment and feedback (8, 22%) as positively affecting their understanding.

Students responding to this question in relation to the stroke package mainly referred to the video clips (23, 38%) as positively affecting their understanding.

Table 4.10 Equivocal / negative comments about the effect of each package on understanding.

Comment Theme	Package			
	Movement Analysis (*n*=93)	Manual Therapy (*n*=36)	Stroke (*n*=61)	Total (*n*=190)
General	11 (12%)	3 (8%)	10 (16%)	24 (13%)
Lack of use	2 (2%)	0	1 (2%)	3 (2%)
Not stand alone package	4 (4%)	0	2 (3%)	6 (3%)
Prefer book / other method of study	0	1 (3%)	0	1 (1%)
Technical problems	1(1%)	0	0	1 (1%)
Videos	3 (3%)	1 (3%)	0	4 (2%)
Confusion about questions / feedback	2 (2%)	2 (6%)	0	4 (2%)
Total Comments per package	23 (25%)	7 (19%)	13 (21%)	43 (23%)

Overall 43 (23%) comments about the effect of the packages on understanding were equivocal or negative. Most of these were general (24, 13%).

The greatest proportion of equivocal or negative comments relating to understanding was elicited by the movement analysis package (23, 25%) and again these were mostly general.

Table 4.11 Positive comments about the effect of each package on the application of learning.

Comment Theme	Package			
	Movement Analysis (*n*=79)	Manual Therapy (*n*=25)	Stroke (*n*=66)	Total (*n*=170)
General	4 (5%)	1 (4%)	2 (3%)	7 (4%)
Reinforcement / revision of knowledge	3 (4%)	3 (12%)	6 (9%)	12 (7%)
Relating Knowledge	22 (28%)	0	0	22 (13%)
Self assessment / feedback	2 (3%)	2 (8%)	0	4 (2%)
Video / Audio	7 (9%)	0	6 (9%)	13 (8%)
Relevance to practical/ clinical / work-based activities	32 (41%)	14 (50%)	39 (59%)	85 (50%)
Related to Summative assessment	4 (5%)	0	4 (6%)	8 (5%)
Total Comments per package	74 (94%)	20 (80%)	57 (86%)	151 (89%)

Overall, 151 (89%) of students' positive open comments were about how they would apply what they had learned from the packages.

The movement analysis package elicited the greatest proportion of positive responses to this question (74, 94%).

For all packages responses to this question were mostly related to practical / clinical and work based activities (85, 50%).

Table 4.12 Equivocal / negative comments about the effect of each package on the application of learning.

Comment Theme	Package			
	Movement Analysis (*n*=79)	Manual Therapy (*n*=25)	Stroke (*n*=66)	Total (*n*=170)
General	4 (5%)	5 (20%)	5 (8%)	14 (8%)
Not stand alone package	0	0	1 (2%)	1 (1%)
Prefer book / other method of study	1 (1%)	0	0	1 (1%)
Videos	0	0	1 (2%)	1 (1%)
Related to Physiotherapy	0	0	2 (3%)	2 (1%)
Total Comments per package	5 (6%)	5 (20%)	9 (14%)	19 (11%)

Overall, 19 (11%) of students' equivocal or negative comments were about how they would apply what they had learned from the packages.

The manual therapy package elicited the greatest proportion of negative or equivocal responses to this question (5, 20%). These were general comments.

For all packages equivocal or negative responses to this question were mostly general comments (16, 9%).

Table 4.13 Reasons for liking the packages.

Comment Theme	Package			
	Movement Analysis (*n*=129)	Manual Therapy (*n*=38)	Stroke (*n*=132)	Total (*n*=299)
General	21 (16%)	11 (29%)	15 (11%)	47 (16%)
Reinforcement / revision of knowledge	12 (9%)	3 (8%)	11 (8%)	26 (9%)
Understanding / Using terminology	4 (3%)	0	2 (2%)	6 (2%)
Relating Knowledge	15 (12%)	0	1 (1%)	16 (5%)
Self assessment / feedback	17 (13%)	6 (16%)	12 (9%)	35 (12%)
Video / Audio	18 (14%)	7 (18%)	30 (23%)	55 (18%)
Clarification	1 (1%)	0	7 (5%)	8 (3%)
Alternative method of study	10 (8%)	5 (13%)	13 (10%)	28 (9%)
Relevance to practical/ clinical / work-based activities	2 (2%)	0	3 (2%)	5 (2%)
Ease of Use/ Access	18 (14%)	4 (11%)	23 (17%)	45 (15%)
Related to Summative assessment	3 (2%)	0	0	3 (1%)
Total Comments per package	121 (94%)	36 (95%)	117 (89%)	274 (92%)

Overall, 274 (92%) students gave reasons for liking the packages.

The stroke package elicited the greatest proportion of positive responses to this question (117, 89%). Reasons for liking the stroke package were mostly related to the video clips (30, 23%).

Most reasons for liking the movement analysis package fell into the general theme (21, 16%), this was also the case for the manual therapy package (11, 29%).

Table 4.14 Reasons for not liking the packages.

Comment Theme	Package			
	Movement Analysis (*n*=129)	Manual Therapy (*n*=38)	Stroke (*n*=132)	Total (*n*=299)
General	0	0	3 (2%)	3 (1%)
Lack of use	1 (1%)	0	0	1 (0%)
Not stand alone package	1 (1%)	1 (3%)	0	2 (1%)
Prefer book / other method of study	0	0	1 (1%)	1 (0%)
Technical problems	4 (3%)	0	3 (2%)	7 (2%)
Videos	1 (1%)	0	1 (1%)	2 (1%)
Confusion about questions / feedback	1 (1%)	1 (3%)	4 (3%)	6 (2%)
Related to Physiotherapy	0	0	5 (4%)	5 (2%)
Total Comments per package	8 (6%)	2 (5%)	17 (13%)	27 (9%)

Overall 25 (8%) students gave reasons for not liking the packages.

The stroke package elicited the greatest proportion of responses to this question (15,11%). These were mainly general (6, 5%).

Reasons for not liking the movement analysis package were related to technical problems (4, 3%).

There were only 2 (5%) reasons for not liking the manual therapy package, one relating to confusion about the self assessment questions and feedback and the other that it is not a stand alone package.

Table 4.15 Positive comments on reflecting on learning experience.

In this instance *n*= the total number of responses for each package to the question on reflection.

Comment Theme	Package		
	Manual Therapy (*n*=38)	Stroke (*n*=90)	Total (*n*=128)
General	7 (18%)	20 (22%)	27 (21%)
Reinforcement / revision of knowledge	5 (13%)	7 (8%)	12 (9%)
Relating Knowledge	0	2 (2%)	2 (2%)
Self assessment / feedback	7 (18%)	4 (4%)	11 (9%)
Video / Audio	4 (11%)	17 (19%)	21 (16%)
Clarification	0	5 (6%)	5 (4%)
Alternative method of study	4 (11%)	10 (11%)	14 (11%)
Relevance to practical/ clinical / work-based activities	1 (3%)	7 (8%)	8 (6%)
Ease of Use/ Access	0	1 (1%)	1 (1%)
Total Comments per package	28 (74%)	73 (81%)	101 (79%)

Students were only asked to reflect on their learning experience in relation to the manual therapy and stroke packages and 101 (79%) responses to this question were positive.

The proportion of positive responses to this question was similar for both packages, the manual therapy package eliciting 74% (28) and the stroke package 81% (73).

Most positive responses to this question for the manual therapy package were either general (7, 18%) or related to self-assessment and feedback (7, 18%).

Most positive responses to this question for the stroke package were either general (20, 22%) or related to the video clips (17, 19%).

Table 4.16 Equivocal / negative comments on reflecting on learning experience.

Comment Theme	Package		
	Manual Therapy (*n*=38)	Stroke (*n*=90)	Total (*n*=128)
General	2 (5%)	6 (7%)	8 (6%)
Lack of use	1 (3%)	2 (2%)	3 (2%)
Not stand alone package	2 (5%)	1 (1%)	3 (2%)
Prefer book / other method of study	1 (3%)	4 (4%)	5 (4%)
Technical problems	1 (3%)	0	1 (1%)
Videos	2 (5%)	4 (4%)	6 (5%)
Confusion about questions / feedback	1 (3%)	0	1 (1%)
Related to Physiotherapy	0	2 (2%)	2 (2%)
Total Comments per package	10 (26%)	19 (21%)	29 (23%)

On reflecting on the learning experience of the manual therapy and stroke packages 29 (23%) responses to this question were equivocal or negative.

The proportion of equivocal / negative responses to this question was similar for both packages, the manual therapy package eliciting 26% (10) and the stroke package 21% (19).

Most equivocal / negative responses to this question for the manual therapy package were either general or related to the videos or the fact it is not a stand alone package (2, 5%).

Most equivocal / negative responses to this question for the stroke package were general (6, 7%).

Chapter 4 Discussion

Introduction

Computer-based e-learning technology has the potential to provide increased accessibility to clinically relevant materials for self-study (Cennamo & Dawley 1995). The use of multimedia and interactivity may facilitate self-study in students with a wide range of learning styles and approaches (Ford & Chen 2001). Few computer-based self-study materials had been specifically designed and evaluated for health science students with module learning outcomes in mind. Questionnaires have proved valuable in evaluating the opinions of students using such materials. Draper et al (1996) has suggested an integrated evaluation where information is collected about the materials through their use in the learning environment for which they were designed. Previous comparisons of computer based and conventional learning suggested differences between attitudes to computer-based learning for different genders, ages and course groups of students. It was therefore important to investigate whether this was the case for these packages to ensure their appeal to all groups of students and avoid disadvantaging those with less positive attitudes.

Green et al (2003) used recent advances in tracking technology to investigate how students used computer-based materials but a relationship between use and improvements in learning had not been investigated. This study therefore investigated the opinions of different groups of Health Science students, their use of and scores with various computer-based packages developed with specific learning outcomes in mind. It was intended that this information will be used to inform the further development and improvement of similar computer based e-learning materials for these groups of students. The main aim of this project was therefore to develop and

evaluate web-based self-study packages to support campus based Health Science courses. Different ages, genders and course groups of students using the packages were compared and preferences in relation to types of delivery examined. The relationship between student activity and the effect on learning with the Manual Therapy and Stroke packages was also investigated.

The study development and evaluation has evolved during the course of its implementation. Several factors contributed to the need for this evolution. Technology itself is not a static medium and the advances, particularly in access to the Internet over the last five years during the time in which this study was conducted have been significant. The need for development of the first, Movement Analysis package arose directly as a response to a lack of opportunity for students to practice observational movement analysis on their own and receive feedback. A pilot version of the Movement Analysis package was developed and evaluated. Results of this pilot study confirmed the decision to continue to develop and extend this package. The pilot revealed that few alterations to the package content and design were required. The need for similar packages to facilitate self-study of Manual Therapy and Stroke was also identified. Very few students chose the neutral option in the Likert scale evaluating attitudes towards package features and this was therefore modified to a four point scale to elicit focussed responses from students (Percival et al 1993).

Early evaluations revealed technical problems associated with the slowness of computers in relation to playing the video clips and unreliability of the software to allow consistent access to the self-assessment features. The faculty in which the study was conducted moved to a new facility and this enabled greater and improved

computer access for students. The advent of streamed video allowed this to be incorporated into the packages replacing Mpeg clips. There was some unanticipated initial incompatibility identified between the students' computers and the streaming server causing problems with accessibility of the video clips. These problems were solved through discussions with the information technology and e-learning departments at the university.

The first version of Questionmark Perception was deemed unsuitable to provide question software for the Movement Analysis package. Following the pilot study the subsequent availability of versions two and three allowed this software to be used to develop the Manual Therapy package and Stroke packages and to employ tracking facilities to evaluate student performance. Evaluation of the Movement Analysis package was ongoing during the development period of the Manual Therapy and Stroke packages. The structure of the Movement Analysis package remained unchanged through the course of the evaluation despite evidence that Questionmark Perception provided a more reliable and customisable software for development of the packages. This decision was taken, despite problems with the cumulative scoring of the Movement Analysis package, to allow comparison between the different groups of students evaluating the package. Evaluation of the Movement Analysis package remained positive despite these problems. Updating of the package into the Questionmark Perception format is on going.

Improved navigation facilities became available during development of the Stroke package and these were incorporated into this package. Results confirm that students

felt this package provided the optimum layout for these types of computer-based self-study materials. It was again felt that updating of the other packages should take place once these initial evaluations were complete.

The Physiotherapy and Sports and Exercise Science courses also underwent many developments and re-validation processes. Scientific studies require a lack of variability in the environment in which they are conducted in order to produce comparable and robust data, however for the reasons given many other uncontrollable factors have influenced the conduct of the study and probably the results. The fact that packages were integrated into the traditional module teaching during their evaluation will also mean that any effects seen in learning will be due to a combination of the packages themselves as well as traditional teaching methods.

This chapter will discuss the findings of the study in relation to the aims, strengths and weaknesses of the method and implications for future practice and research in concordance with the recommendations of Docherty et al (1999). The meaning of the findings will then be discussed in relation to implications for practitioners and / or policy makers; finally, unanswered questions and future research required should be presented. Fulfilment of aims and objectives for the project will be discussed in turn in relation to key findings for all three packages. Key findings will be compared with those of similar previous studies and strengths and weaknesses of the method will be integrated in relation to the limitations of their interpretation. The implications of the findings for teaching and learning in terms of practice, future course developments and further research will then be discussed. Finally, main conclusions will be summarised.

Discussion of key findings

This section will discuss the findings in relation to fulfilment of the aims of the study for all three packages. Development of the packages was based on the learning requirements of the students by relating the development objectives of the packages to the learning outcomes of the modules in which they were to be integrated and used as suggested by Biggs (1999). Draper et al (1996) suggests that the ultimate measure of effectiveness for computer-based learning materials is whether they fulfil the purpose for which they are designed. With this in mind this section will also discuss whether the findings allow confirmation that the packages have met their developmental requirements, facilitating student learning in relation to the modules they were designed to support.

The development objectives for the Movement Analysis package differed from those of the Manual Therapy and Stroke packages in that this package was developed in order to allow students to actually practice the observational skill of movement analysis. Although development objectives for the Manual Therapy and Stroke packages differ they were both developed to allow students increased access to supplementary visual study materials and allow consolidation and testing of their knowledge in relation to these subjects. However the Stroke package also requires observational skills to answer some of the questions. It may be that the movement analysis package has also allowed for some consolidation of knowledge in relation to applied anatomy. The results of the open questions about how the packages have affected knowledge, understanding and application will reveal whether this occurred.

Students' attitudes towards computers

The attitudes of different age groups, genders and course groups towards computers were investigated and compared. Negative attitudes towards computers may make students more reluctant to use computer-based learning materials. This was investigated by Vuorela & Nummenmaa (2004) who found more negative attitudes and beliefs did not limit the use of their web-based learning materials though students whose anxiety levels were high had lower expectations of the learning environment. Participants who developed more negative attitudes to the environment following the course may also be more reluctant to participate in such learning activities in future (Vuorela & Nummenmaa 2004). Previous research suggests that male students (Hernandez-Jorge et al. 2003; Richardson 2001) and those with increased experience of computer technology (Van Dover & Boblin 1991) have more positive attitudes towards e-learning. Results of this study are discussed in relation to these previous findings.

Use of a questionnaire to discover student attitudes about computer based learning has been widely and successfully used in other studies (Dewhurst et al 2000; Kohlmeier et al. 2000; Lyte & Kerr 1996; Richardson 2001). It was therefore felt that this was an appropriate means of collecting such data in this study. Unfortunately confidence levels and opinions of students towards computers were not collected prior to their use of the packages and thus comparisons cannot be made with their post-use attitudes and confidence to discover any changes to which the packages may have contributed in this study. Assumptions were made about statement relating to attitudes towards computers in relation to those expressing a positive or negative attitude. For example the statement:

"Anyone can use a computer."

was interpreted positively if agreed with but agreement with this statement, though less likely, may also stem from a negative attitude. Other researchers have had problems in defining what indicated a positive or negative attitude towards computers (Noyes & Garland 2005). It is suggested that attitudes have cognitive, behavioural and perceived control components (Noyes & Garland 2005). Statements in the Likert scale contained a combination of these elements and this strengthens their validity.

Students using all three packages exhibited positive attitudes towards computers. They tended to disagree with the negative statements and agree with positive statements about computers. There was consistency in students' opinions in that over 90% of students evaluating each of the three packages agreed or strongly agreed that anyone can use a computer and that computer literacy would make them more employable. The main area of concern expressed by students across all three packages was related to 'computers isolating you from others'. Positive student attitudes towards computers following use of the packages may motivate the student to make more use of this type of learning in the future either in their current course or in postgraduate study. Many post graduate courses have distance-learning components and the incorporation of computer-based activities is increasing. Positive experiences with and attitudes towards computer-based learning in undergraduate education may therefore better equip students for the demands of lifelong learning.

Students evaluating the Movement Analysis package were in significantly more agreement than those evaluating the Manual Therapy package that computers isolate

you from others ($p < 0.001$). They also significantly differed from students evaluating the Stroke package in their strong disagreement with being 'afraid of looking silly if making a mistake while using the computer' ($p = 0.012$). These findings suggest that although students evaluating the Movement Analysis package tended to exhibit similar attitudes towards computers than the other cohorts they were more polarised in those opinions. This may be because the Movement Analysis package is delivered in first year when students may exhibit stronger opinions as they try to establish their identity within this new environment. This was also possibly their first exposure to computer based learning within the university setting. Having the opportunity to study with other students rather than in isolation may be more important to first year students, particularly those who have chosen a campus-based course as they want to make new friends. This could also influence their opinions about how they are perceived by others and explain why they may be more anxious not to appear "silly" in front of their peers.

Students' attitudes to and confidence with computers were only evaluated following package use therefore it could not be determined whether their attitudes and confidence changed following package use. The positive post-use attitudes displayed by students in this study differ from the more negative post-use attitudes developed by students in the study by Vuorela & Nummenmaa (2004). Although they found that students prior attitudes were not predictive of post-experience attitudes their findings and those of Jones & Kember (1994) suggest that students with more positive attitudes are more likely to adopt a deep approach to study. Selwyn (1997) comments that providing access to hardware and software without knowledge of learners' inclinations to use technology does not contribute to effective integration. Positive

attitudes to computers and confidence in their use contribute to students' inclination to use computer-based materials. It is therefore reassuring that student attitudes in this study were mainly positive towards computers regardless of which package they were using.

Students mostly reported confidence with all the computer-based activities in the Likert scale across the three package evaluations. Despite this under half (46%) of students evaluating the Movement Analysis package were confident or very confident in using computer based multimedia. Statistical comparison of students evaluating the three packages revealed an apparent significant difference between the Movement Analysis evaluation group and the other groups regarding their confidence with this activity ($p = 0.012$). On further post hoc testing to compare each package with the others no significant difference was demonstrated. It may be that students had more experience with the other types of computer based activity than using multimedia. This technology is relatively new and has seen advances in recent years particularly during the period of data collection of this study. Young people are increasingly exposed to computer-based multimedia through downloading music and video clips and may now create their own clips using mobile telephones and digital cameras. These advances could influence students' expectations regarding the use of technology and multimedia in their learning environments and the quality that is expected. Continued investigation of different groups of students with these activities would allow greater understanding of the relationship between advances in and familiarity with these technologies and students' confidence in using them for learning.

It is reassuring that students were largely confident in using computers for web-based activities, and studying on line. This differs from the findings of Van Dover & Boblin (1991) who found that although student nurses had very positive attitudes towards using computers for learning they were mainly used for word processing activities. It is possible that students recently entering higher education do not view the use of computers as something out of the ordinary but as technology has progressed over the last decade students are familiar with their use in learning through exposure during their primary and secondary education. Lecturers and learning providers who are less familiar with these technologies therefore have an obligation to update their skills if they are to provide an educational experience that is technologically relevant to students' expectations. Haigh (2004) suggests that if Virtual Learning Environments (VLE) are to become more than just "on-line filing cabinets" academics need to develop the skills to use them more effectively. This view is echoed by Rogers (1998) in a report for the Joint Information Systems Committee in which she advises that students are entering higher education courses with a very wide range of information technology skills. However, as staff skills are variable in range, as are levels of confidence in using information technology, training and staff development programmes need to be put in place. These need to be large scale programmes because of the numbers of staff involved and the need to be sustainable (Rogers 1998).

Students' high post-use confidence levels may also indicate that the introduction and training they received prior to using the packages was of a satisfactory standard. Differences in confidence and attitudes between genders were not analysed in this study. The majority of students evaluating the packages were female, thus the

generally positive attitudes and confidence exhibited by most of the students would seem to differ from previous studies suggesting less positive attitudes towards this form of learning among female students (Ford & Chen 2001; Richardson 2001). Further investigation into pre- and post-use attitudes and confidence in computer based learning with comparison between genders and age groups would allow deeper understanding of the effects of this form of learning among different ages and genders of students. It was felt more useful for this particular study to compare the attitudes of different ages and genders of students in relation to the specific packages and their features rather than computers in general. This would further inform the continued development of these types of packages.

Students' attitudes towards the packages

This section will discuss the findings of the evaluation questionnaires for each of the packages with reference to the results of the Likert scale relating to attitudes towards the package and open question responses.

The use of Likert scales allowed comparison of attitudes towards the packages to be made and possible reasons for these attitudes could be further investigated through the open questions. The Likert scale was a four-point scale with no neutral option. This type of scale has been used effectively in a similar study by Madariaga et al (2003). Students not understanding the statement requiring response or not having an opinion one way or the other could therefore not choose this option. However the pilot study indicated that statements were generally understandable and very few students chose a neutral option. Students were provided with only four responses to elicit more definite

opinions as suggested by Percival et al (1993). It may still be however, that students who did not have a definite opinion chose a more positive response although they could equally have chosen a more negative response thus statistical compensation should occur. Confusion or lack of opinion towards a statement may also have manifested in students choosing not to respond on the Likert scale but although a few responses were missing numbers of these were very low and did not correspond to a particular statement. It is therefore felt that a four-point Likert scale provided a useful tool in collecting this type of data.

Open questions elicited issues regarding feedback, question structure and access, which were not specifically addressed by the Likert scale. In future studies the scale could be refined to allow inclusion and therefore comparison of attitudes to these features. Analysis of the open questions risks different interpretations of themes between investigators. However steps were taken to ensure themes were correctly identified, by comparing them with those of a colleague uninvolved in the study. This ensures more robust interpretation of this type of data (Cohen et al 2000). Nevertheless it remained difficult to distinguish between positive, equivocal and negative comments although attempts were made to specifically classify comments as positive if they were overtly praising in nature. Equivocal comments were judged as those giving information rather than expressing feelings of positivity or negativity. Negative comments were more obviously identified. Sole use of this data to elicit students' attitudes would not allow for robust statistical comparisons to be made but it is useful in triangulating the results of the Likert scales and to allow deeper understanding of students' attitudes.

Overall attitudes towards all the packages were positive and very few negative responses were elicited either by the Likert scales or the open questions. Although it is tempting to assume that this reflects the students' great enthusiasm for all the packages other possible reasons for this should be examined. The study was conducted entirely by the author with students aware that their comments, whilst anonymous, would be interpreted and collated by this lecturer. Students may have wanted to create a positive impression on the investigating tutor and so may have been reluctant to give negative feedback. This is unlikely as the author was not directly involved in any of the summative assessments of the modules supported by the packages making students less likely to perceive these impressions as influencing their module marks.

These results will be discussed in relation to the development objectives for each package to enable conclusions to be drawn about whether these have been met. The results of the comparison of students' attitudes between packages will also be discussed.

Movement Analysis Package

This package was developed following identification of the need for students to receive feedback on their self-study of anatomical movement analysis. The package was specifically designed to allow students to access video clips of normal functional movements with linked self-assessment questions on the anatomical analysis of these movements. Students were then able to receive feedback on their attempts at analysing these video clips and thus review this skill prior to assessment. The package also contains links to movement and muscle glossaries to allow students to access related anatomical theory. One hundred and twenty four students evaluated the

Movement Analysis package giving a reasonable sample size from which to draw conclusions.

Over 80% of students exhibited positive attitudes towards the Movement Analysis Package. Ninety percent of students said they liked using the Movement Analysis package, they also found it enjoyable and would consider spending time using it to study. Reasons given for liking the package related specifically to ease of use, easy access and the video clips. The most beneficial feature of the package identified by students was that it helped them to learn about the topic. They also found the videos worthwhile in supporting their learning and valued access to the glossaries. The package was deemed useable through ease of navigation and satisfactory advice on working through the material.

This would seem to suggest that the package was meeting its development objectives by providing a resource enabling students to learn about movement analysis. This assumption is supported by responses to the open questions. The most commonly described positive effect of the package on learning related to improving students' general knowledge of anatomy. Students also described that the package allowed them to relate their knowledge of anatomy to its practical application and to revise the subject. This is particularly relevant to the Movement Analysis package as it was originally developed as a revision aid to prepare for the practical viva. Although none of the statements in the Likert scales related directly to feedback students referred to self-assessment and feedback in describing reasons for liking the package.

Nearly all students found the presentation informative and that it fitted well with the rest of their course material. It is generally agreed that well-designed learning materials providing students with the opportunity for self-assessment and feedback that are linked with their existing knowledge will encourage deep rather then surface learning. The importance of this relationship has been well described by Race (1994), Lawton (1996) and Entwistle et al (2000).

A surprising result of the open questions was the high percentage of students (41%) reporting the applicability and relevance of the package to clinical or work-based activities. The package was distributed to first year students who had no clinical or work based experience in their course thus far so it was not anticipated that the package would facilitate recognition of practical applications relating to this. Hoyles et al (2000) describe the importance of students being able to relate theory to practice and report that previous studies on nurses have shown that for many students theory has no context or meaning. The authors comment that this was seen particularly in relation to students in the early part of their course when theory is delivered intensively before students have any clinical experience. It was also noted that students became bored and disillusioned with traditional theoretical study (Hoyles et al. 2000). This is however the model used for many Health Science courses. At Robert Gordon University, for example, the students' first semester is entirely theoretical and delivered across course groups so that students have little exposure to clinical or work based experiences and may feel unable to develop a sense of professional identity. These results would suggest that computer-based self-study materials such as the Movement Analysis package could contribute to addressing this problem. Although this package is delivered in the second semester, in profession-

specific modules it might be advantageous to develop similar packages to support earlier common modules such as pathology.

In order to determine areas of the Movement Analysis package requiring further improvement and development it is also important to consider the features provoking most dissatisfaction. Strong disagreement was only expressed twice: once in relation to the time spent being worth it and again in relation to the package helping revision. The Likert scale revealed that 10 - 15% students felt there was not enough advice on how to work through the material, it was not easy to navigate, not enjoyable, time spent was not worth it and they wouldn't use it again in their own time. Reflecting on students' equivocal and negative open comments may suggest reasons for these feelings. Some students commented that their lack of use was due to their full timetable or that they just preferred other methods of study. There were some students who described problems with the videos and encountered technical problems. These comments will help to focus areas in which the package should be improved.

Providing more guidance on how to work through the package would ensure no students are demotivated or disadvantaged through struggling to navigate through the material. It was thought that by a tutor introducing students to the package in a class at the beginning of the module this, along with the instructions on the first page of the package, would be sufficient to guide students' use. However it is possible that as the package was introduced early in the module students may not have developed enough insight into the topic to allow them to fully understand the way in which the package was to be used. If this was the case it could certainly effect the degree to which students used and accessed the package. Unfortunately information on use and access

is unavailable for this package, as tracking information was not accessible through the software used to create it. It is important to introduce the students to the package early in the module to allow them to have flexibility in deciding when and how to use it. Nevertheless, a more detailed reminder of the points covered in this session regarding its use could be integrated into the on-line instructions and allow students to re-visit this information as needed.

Other negative comments related to confusion regarding feedback and the marking system; this may have resulted in some students feeling that it did not improve their understanding. These comments, although few, will allow further improvement and development of the package to ensure potential problems do not recur. Most of the students' suggested improvements required to the package were indeed related to clarifying marking and feedback. The Movement Analysis package software did not employ the use of the recent version of Question Mark Perception allowing specifically tailored and detailed feedback. Problems were also identified with the cumulative scoring. Any future version of the Movement Analysis package based in Question Mark Perception would have an improved marking and feedback facility for the students by allowing feedback to be appropriately detailed and scoring to be more reliable. Comparison of these features in relation to the other packages may show whether marking and feedback in the Question Mark Perception format is more readily interpreted.

Reasons for disliking the Movement Analysis Package were mostly related to technical problems. Some students did suggest improvements suggested improving or increasing access. Technical and access problems may have occurred during the initial development stages of the package before the faculty moved to a newer building and

better computing facilities. Comparison with the more recently developed packages may uncover whether these factors remain problematic. Overall it is felt that the package generally met its development objectives, although features requiring improvement are:

- More detailed on-line instructions on how to use the package.
- Improved marking and feedback
- Addressing technical problems and monitoring student use and access.

Manual Therapy Package

This package was developed in response to suggestions made by the pilot focus groups. Its purpose was to allow students to review the correct application of manual therapy techniques through watching video clips, listening to instructions and answering self-assessment questions about their clinical application. Only 39 students evaluated the Manual Therapy package therefore caution should be exercised in drawing conclusions based on this small sample. The sample size was smaller as the package is specific to the physiotherapy course. . Evaluation forms were received from only 20 of the 46 BSc (Hons) Physiotherapy intake 2003 students. All of these students were invited to the timetabled feedback session during which the on-line version of the evaluation form was used. There were some technical difficulties with the server that prevented some of the evaluations from being submitted. Students were also provided with a back up hard copy of the evaluation form and invited to complete this version. It is possible that students didn't want to complete a second evaluation following failure of their original submission and that this contributed to the low response rate. This highlights the importance of making available paper-based back-up resources should technology fail. Further evaluations need to be undertaken with other groups of these students to give credence to these preliminary findings.

Over 90% of students agreed or strongly agreed with the positive statements about features of the Manual Therapy package. Seventy five percent of students liked using the package. All students agreed that the information on screen was easy to read and all but one student thought it was easy to navigate and informative. This suggests that students found the package useable. The high proportion of students agreeing that the Manual Therapy package has clear options and instructions, supports this assumption. The information the students were required to read consisted of the instructions and the questions. Information relating to Manual Therapy techniques and practice was delivered through the video clips. It is reassuring that the video clips were also highly valued. Kirschner (2002) suggests that study materials designed with integration between visual and textual information that are clearly presented will reduce extraneous cognitive load and allow students to develop long term cognitive schemas. This will therefore improve their consolidation and understanding of the information they are required to process. Application of these design principles to computer-based learning materials may encourage students to adopt a deeper approach to self-study (Mayes 1997) . Students' approval of the design of the Manual Therapy package indicates that it should promote consolidation and understanding of the topic rather than hinder it.

Most students felt that the package was a useful resource, which supported their learning and revision and fitted well with the rest of their course material. Open responses supported the perceived positive effects of the package on learning, particularly in relation to general knowledge of Manual Therapy. Students' positive comments mostly included reference to self-assessment and feedback features of the

package in supporting their general knowledge and understanding of Manual Therapy. Narciss (1999) has commented on importance of informative feedback in motivating learners. A commonly-described advantage of computer based learning is in allowing students to fail and retry while receiving prompt and relevant feedback (Race 1994; Van der Velden 1999). It is therefore hoped that if these features of the package are well designed then maximum benefits of this type of learning will be achieved. The version of Questionmark Perception software used to create this package allows tailoring of the content, type and delivery of feedback. The Manual Therapy package thus provides a more highly valued form of feedback than the Movement Analysis package. Future use of Questionmark Perception software to improve feedback in the Movement Analysis package would seem to be indicated particularly if this form of feedback is equally supported by the Stroke package.

Clinical relevance of the Manual Therapy package was desirable, allowing students access to study current and appropriate practical skills. Bahn (2001) has suggested through demonstration and verbalisation of practical skills, aspects of a task not clearly visible can be explained. Kaufman (1997) has also suggested that role models have a major impact on students' learning and thus it was important that the videos in the Manual Therapy package reflected these characteristics. When asked how the Manual Therapy package affected the application of their learning 50% of students' positive responses related to the clinical relevance of the Manual Therapy package. A high rate of positive responses indicate that the package was clinically relevant, allowed students to visualise and learn about Manual Therapy and enabled them to test their knowledge suggesting the fulfilment of its requirements.

The negative feedback from students about the Manual Therapy package will now be discussed. Twenty three percent of students disagreed or strongly disagreed that the Manual Therapy package was enjoyable to use. Strong disagreement was only expressed 3 times in relation to navigation, consistency of procedures and the videos. Although the Likert scale responses were extremely positive the percentage of students who liked (75%) and enjoyed (77%) the package was relatively low. It is possible that this may affect student motivation to use the packages so it will be important to analyse these features in relation to the Stroke package to attempt to understand possible reasons for this. It is possible that differences in enjoyment may be purely down to the subject matter being studied and not the construction or design of the packages.

Almost one fifth of students found procedures within the package inconsistent. It is possible that the wider variation of question styles in this package compared to the Movement Analysis package lead to this response. Students use this package later in the course than the Movement Analysis package and may have expected it to follow a similar structure. Provided students are confident in responding to these variations problems should not arise. Bull et al (1998) suggested that a lack of flexibility in their software had led to students evaluating their self-assessment materials as too shallow. It was hoped that by providing variation in the question styles this would challenge the students in different ways and appeal to a broader range of learning styles which could be advantageous for learning (Kolb 1984).

There were very few equivocal and negative comments made in response to the open questions. Comments were mostly general and unspecific in nature but there were

three negative comments regarding confusion over the questions and feedback. There were two reasons given for not liking the Manual Therapy package one relating to access, the other from a student who also made the same comment when reflecting on how the package had affected his/her learning. This comment revealed a lack of understanding about how the package should be used:

"It hasn't affected the way I learn I felt pressured to do well so I learned the answers not the understanding of the questions also the test could have been done without practising as the questions were different."

Even though this is an isolated remark it illustrates a superficial approach (Entwistle et al 2000) to learning by this student who was obviously hoping that if the answers to the question were rote learned they could just be reproduced in the test and he/she would do "well". It is therefore unsurprising that the student was aggrieved that the test version contained different questions and shows the importance of using assessment methods to test understanding and application of knowledge they have gained rather than just recall of that knowledge. It is of concern that a student should consider rote learning of practical techniques acceptable as it is extremely important for physiotherapists to apply techniques differently to patients depending on the clinical problems identified (C.S.P 2005). Although the test used to evaluate student performance following use of the packages was formative, it consisted of questions students would be likely to be asked in their summative practical assessment or on clinical placement. Through these assessments students lacking the ability to apply these techniques appropriately may be identified.

Students only gave two reasons for not liking the Manual Therapy package: one student complained about the test version not counting towards the module mark and the other found difficulty finding computers to access it. Although only 2 students gave reasons for not liking the Manual Therapy package 25% of students said they did not like using it. Examining the two reasons given allows identification of areas for future development of the Manual Therapy package. The test version was deliberately designed to be formative as at the time it was felt that evaluation of the package should be completed before summative versions of the package were considered. The packages were not designed to replace conventional assessment methods but to provide a means of study for students allowing reinforcement of practical techniques. It may be possible to devise a summative version of the package but this would require further research. Difficulty in accessing computers may have been due to the package's use of streamed video. This type of video clip required the students to use only certain computers enabled to play the streamed clips due to an incompatibility with the servers (video streaming was just being introduced in the university at the time). This has now been rectified and students should be able to use the packages on any of the university computers. These technical difficulties will be discussed further in following sections.

Forty four percent of students said they could suggest improvements to the Manual Therapy package. Most of the suggested improvements were related to increased or improved access. Some of these comments related to the problems with the video clips identified previously. Some comments related to extending the package and suggested including links to other relevant information and further reading materials. It was intended, through delivering the package via the VLE, that other related

materials would be available via the same interface as the package and that this would provide an integrated repository for the course materials. This has been suggested as an advantage of basing these materials within a VLE (Van der Velden 1999). However other tutors are responsible for providing and maintaining the supporting information for this module on the VLE and it may be that staff training is required to facilitate the best use of this resource. It is hoped that evaluations such as this can contribute to identifying these needs, which will be further discussed in following sections.

In summary it is felt that the Manual Therapy package mostly fulfilled its development objectives. Specific areas requiring further improvement and development are:

- Ensuring students understand the context in which the Manual Therapy package is to be used.
- Continuing to ensure that students have access to the package on all the university computers.
- Improving and extending links to other relevant material and providing training for other module staff involved.

Stroke Package

This package was also developed in response to suggestions made by students in the pilot study that they would like computer-based materials which were based on different patient conditions. Stroke was chosen as the first condition as students need to visualise the features of this type of patient to fully understand the management principles involved (Bernhardt et al 2001). Access to observational hospital visits previously providing this resource had become impossible to continue due to large student numbers. It was hoped that the Stroke package would therefore allow students to visualise the clinical features, assessment and treatment of a patient suffering a Stroke. Self-assessment questions were included to facilitate the testing of students knowledge and understanding and allow consolidation of the information. Ninety-five students evaluated the Stroke package which is considered a reasonable sample size from which to draw conclusions to inform the further development of the Stroke package.

At least 90% of students valued the features of the Stroke package and said they liked using it. The most common reasons given for liking the Stroke package related to the video clips. All students thought there were clear instructions on how to use the Stroke package and all but one thought procedures were consistent and information on screen was easy to read. The results regarding consistency of procedures throughout the package are marginally more positive than those of the Manual Therapy package. There is an equivalent variety of question formats within the Stroke package to that in the Manual Therapy package. Variety of question styles may therefore not be responsible for some students' perceived lack of consistency in the Manual Therapy package as previously considered. As the Stroke package is used later by the students

it may be that familiarity with these question formats has made them more accepting of these variations. The Occupational Therapy students who evaluated the Stroke package had not previously used either of the other packages and so were new to this form of learning as there are no similar materials in their course up to this time. It is therefore reassuring that they found these features of the package acceptable.

Ninety eight percent of students also agreed or strongly agreed that there are clear options at each stage and that the package is easy to navigate. This suggests that navigation and usability were satisfactory which could lead to improved motivation to use the package (Wolfson 1996). Navigation of the Stroke package was slightly different from the Movement Analysis and Manual Therapy package, which employ a scrolling method of navigating through the questions. The Stroke package, developed most recently, made use of navigation buttons allowing one question to be presented to the student at a time. They can use the buttons to see how many questions there are, to determine which have been completed and flag up those they want to go back to later within each package section. Presenting students with a minimum of extraneous information and focussing their mental efforts on the task in hand has been shown to have a positive effect on learning by reducing extraneous cognitive load while facilitating the increase of germane cognitive load (Bodemer et al. 2004). It was thought that some students may have difficulty understanding this method of navigation so detailed instructions were provided on-line to allow students to re-visit them as required. Most students (97%) found the presentation of the Stroke package informative.

The videos were also an important component of the package as were features relating to revision and learning. Over 90% of students thought the videos worthwhile. The same high proportions also thought the Stroke package was a useful resource which fitted well with the rest of the course material, helped learning and revision. The largely positive attitudes of students towards these features suggest the Stroke package fulfils its purpose. Students' open comments provide further evidence of positively valued features of the package. Most (84%) open comments made by students evaluating the Stroke package were positive. The majority of positive comments were made in reflecting on the learning experience with 74% of students reflecting positively on the learning experience. Many commented on the positive influence of the video clips. Again, students' positive attitudes to the video clips suggest that use of clinically relevant materials using clinicians as role models has a positive effect on students perceptions of their learning experience. These findings differ from those of Green et al (2003) who found that although students enjoyed using their learning materials, including videos, only 25% of students were very confident that these materials positively affected their learning. Again this re-enforces the assumption that the package has fulfilled its development objectives in terms of providing a useful learning resource to support students learning within the Neurology modules.

Even though the results of the questionnaire evaluation of the Stroke package appear overwhelmingly positive, examining those features provoking disagreement and negative open comments will allow areas for improvement to be identified. Although there were very few equivocal and negative open responses some of these referred to the package being too orientated towards physiotherapy. This was also given as the

most common reason for not liking the package. These comments originated from the occupational therapy cohort. During development of the package it was hoped that there would be common questions for physiotherapists and occupational therapists but also profession-specific components containing physiotherapy and occupational therapy activities and self-assessment questions as this format mirrors the module delivery. The occupational therapy tutor involved with the module was on maternity leave, and it was decided to wait for her return in order to develop the occupational therapy components. It was unfortunate that a video could not be made which included the occupational therapists at this point in the package development. During this time, the version of the package delivered to the students was seen to represent activities and self-assessment questions that would have relevance to both professional groups but some students obviously felt that it lacked the correct balance. Some occupational therapy students did, however, comment that it enabled them to see how their physiotherapy colleagues assessed and treated this type of patient. One could assume that if an occupational therapy component were developed it would similarly allow physiotherapy students reciprocal insight into this profession's role with these patients. Barnes (2003) stresses the importance of rehabilitation professionals understanding each other's roles and maintains that a key principle of neurological rehabilitation is the close working together of all relevant health professionals. To ensure goals are set according to the needs and requirements of the disabled individual, rehabilitation team members blur their own roles and work together in an interdisciplinary fashion (Barnes 2003). Packages allowing students insight into the roles of their fellow team members before going on clinical placement may therefore be valuable in helping to support this learning need.

Most improvements suggested related to increasing or improving access (24%) and extending the package (21%). The Stroke package suffered the same problem as the Manual Therapy package regarding access to computers on which to play the video clips (as previously stated, this has now been rectified). One student stated that they could not access the videos from home, as they did not have broadband. It is hoped that with the rapidly expanding availability of broadband and decreasing price future students will not be disadvantaged in accessing these types of study materials. This comment does highlight the assumptions made by package developers that students will have equal access to them. The improvement in accessing the package on the university computers should go some way to ensuring that while on campus students do have equitable access. Access from home could become more of a concern should students require or want to access these materials off campus, while on clinical placement for example. One BSc Physiotherapy (2003 intake) student did suggest that this package be made available permanently. Following the evaluation, a group of students from the BSc Physiotherapy (2003 intake) cohort, who were about to go on neurological and musculo-skeletal clinical placements, requested that all the packages be made available out-with the module links within the VLE. This, they suggested, would then allow open access to revisit the material to support their studies while on clinical placement. Suggested extensions to the package, apart from the inclusion of an occupational therapy section, included the development of similar packages for other neurological conditions and extension of existing question-topics to include neuro-anatomy.

A minority of students (11%) felt that the time they spent using the Stroke package was not well worth it. Seventeen percent of suggested improvements related to the

length of the package in terms of the study requiring too much time. It was hoped that providing the package in sections would allow students to access single components of the package when relevant. It is likely students thought that because the sections were numbered in order, they should always start with section one and work through them sequentially. Examination of the tracking data may allow further testing of this assumption.

In summary, it is felt that the Stroke package fulfilled its development objectives. The main areas requiring improvement and further development are:

- To include profession-specific physiotherapy and occupational therapy components in the package.
- To ensure common elements are correctly balanced.
- To extend packages to include other neurological conditions.
- To investigate the use of these packages as a resource to support learning on clinical placement.

Comparison of students' attitudes towards the packages in relation to age, gender, course group and package used.

This section discusses the comparisons made between ages, genders and course groups of students regarding their attitudes towards the packages. Research suggests that male students (Ford & Chen 2001; Hernandez-Jorge et al. 2003; Richardson 2001) and those with increased experience of computer technology (Van Dover & Boblin 1991) have more positive attitudes towards e learning. Differences have also been found between different groups of students using the similar computer-based learning materials (Vuorela & Nummenmaa 2004). Positive post-experience attitudes

towards the learning environment are exhibited by students who adopt a deeper approach to study (Jones & Kember 1994;Vuorela & Nummenmaa 2004). It is important to investigate potential differences in attitudes to specifically designed computer-based materials rather than just to computers in general. Groups of students with negative attitudes using these materials may feel disadvantaged, de-motivated and take a more superficial approach to their study. This has particular relevance to courses such as Nursing, Physiotherapy and Occupational Therapy where the majority of students are female and there may be a significant number of mature students.

Convenience and not randomisation identified the samples of different student cohorts using and evaluating the packages. The sizes of each group also differed, as would different students' previous experiences educational levels and learning styles. The results of the group comparisons should therefore be interpreted with caution as these other variables have influenced the results. The utilisation of these relatively small convenience samples may also have led to the non-normal distribution of the data and therefore necessitated the use of non-parametric statistical tests which are less robust.

Age group comparison

The different age groups of students studied were those who were 27 and under and those 28 and over. This division was determined by the use of the L.T.D.I. questionnaire. Although this division does not represent that between typical mature students and undergraduate age groups this division was thought more representative of those who may have been exposed to computers in previous educational experiences (at school) and those who had a more traditional educational background. In retrospect, this division became less relevant as the study progressed with recent

intakes of students over 28 having more experience of computer-based learning than earlier cohorts did. Comparison between age groups for attitudes towards all three packages revealed that most students both 27 years and under, and 28 years and over, agreed with the positive statements about features of the packages.

There were slight variations observed in proportions of agreement and disagreement for different features of the Movement Analysis package, but very few students in both age groups expressed strong disagreement with statements about the Movement Analysis package. Both age groups of students strongly agreed the Movement Analysis package helped them to revise the subject. The younger age group of students were statistically more likely to strongly agree that the Movement Analysis package fitted with the rest of the course material than the older group ($p=0.04$) although 64% of older student did agree that the Movement Analysis package fitted with the course material. No other significant differences were found between age groups regarding attitudes towards the Movement Analysis package.

There was some variation in the features of the Manual Therapy package valued by the different age groups, but these did not follow any particular theme such as navigation, usability or effect on learning. Students in the 28 years and over age group tended to choose the options agree or disagree rather than those expressing strong agreement or disagreement, whereas a proportion of the younger age group chose the option of strongly agree. However, there were no significant differences in attitudes between age groups towards the Manual Therapy package.

Comparison between age groups for the Stroke package did not reveal any preferences for particular features. There were no significant differences found in comparison between age groups for the Stroke package.

Hernandez-Jorge et al (2003), found no significant differences between students in different year group cohorts. This may lead one to expect that different age groups of student would not differ in their attitudes towards specific computer-based learning materials. Certainly for the Movement Analysis, Manual Therapy and Stroke packages this would seem to be the case. These findings are at odds with other studies which have found positive links between age and anxiety towards computer use (Czaja & Sharit 1998; Hudiburg 1990). It was thought that there might be more significant differences between the age groups in this study, rather than those found in different year groups, as students were divided into age groups according to likely previous experience with computers in learning. Liaw (2002) found positive links between experience with computers and attitude. It is, however, reassuring that both age groups of students were positive about all the learning materials. It is hoped that the structured introduction to the packages, designing the packages with specific module learning outcomes in mind, and access to tutor support as required assisted in promoting these positive attitudes. Relating packages to existing learning materials has been described as positively influencing students attitudes towards computer based learning materials (Lawton 1996). Availability of tutor support has also been suggested to facilitate positive attitudes (Wolfson 1996). Older adults interacting with computers may have less anxiety if time constraints are reduced (Laguna & Babcock 1997). Allowing students to access and use the packages in their own time therefore possibly contributed to more positive attitudes. The only variation between age groups

appears to be the extent to which the younger students chose the extremes of the Likert scale about package features compared to older students. Younger students also tended to choose the extremes of the Likert scales about attitudes towards computers. This tendency of younger students to choose extreme options has not previously been reported in relation to the use of Likert scales. Findings suggest that age differences are no longer relevant to students' attitudes towards computer-based self-study materials. Future studies should focus on identifying students' prior levels of confidence with computer-based learning and compare these with confidence post-use.

Gender Comparison

Most Health Science professional courses attract a large proportion of female students. Research suggests that male students have more positive attitudes towards computer-based learning than female students (Ford & Chen 2001; Hernandez-Jorge et al 2003; Richardson 2001). Ford et al (2001) found that males learned more effectively in web-based situations when the task they were required to perform was matched with their approach to learning. Richardson (2001) found more negative perceptions among female students working within a VLE than among males. While Hernandez-Jorge (2003) found no significant differences in attitudes between genders where e-learning was concerned, they did find that women expressed more advantages in terms of learning and concerns regarding technical difficulties. Both studies found that women had greater concerns regarding isolation. It is therefore important to discover whether differences of this nature exist between different genders of students in relation to features of the packages developed in this study to ensure neither male nor female students are disadvantaged in their learning.

Both male and female students strongly agreed that the Movement Analysis package would help them to revise the subject. There was some significant variation in features of the Movement Analysis package valued by males and females. Females were significantly more likely to agree or strongly agree that they enjoyed using the package ($p=0.03$) than males. Females were also significantly more likely to strongly agree that the package fitted well with the rest of the course material ($p=0.036$) and that the time spent using it was well worth it ($p=0.006$). Although males did tend to agree with these statements also.

Both males and females tended to agree with the positive statements about the Manual Therapy package. For both males (48%) and females (46%) the most strongly valued feature was the video clips. Although there were some variations in proportions of agreement and disagreement between males and females for other features, no other significant differences were found.

The Stroke package did not elicit any significant differences in attitudes between genders. Both genders tended to agree or strongly agree with the positive statements about the Stroke package. There were some variations in the Stroke package features valued by males and females, but these did not seem to follow any pattern in terms of usability, effect on learning etc.

The main difference found, in this study, between males and females related to enjoyment of the Movement Analysis package, with females enjoying its use more. They also expressed agreement regarding enjoyment of the other packages. Little

disagreement was expressed by either gender towards positive statements relating to technical aspects of the packages. Other variations between males and females did not seem to fall into any discernible pattern. While some differences between genders were demonstrated, attitudes across genders tended to be positive towards all the packages. These findings differ from previous studies which have found more negative attitudes among female students towards computer-based learning (Hernandez-Jorge et al 2003; Richardson J. 2001). Gunn et al (2001) suggest that gender inequalities in computer supported learning, although previously of concern, may be disappearing. They suggest that approaches to this type of learning may differ between genders, but if adequate support is offered to both groups, equal participation can be encouraged. They recommend the incorporation of self-tests in this type of learning to support self-monitoring of performance. Results suggest that students using the packages valued slightly different features, but both genders were positive about their use. This seems to reflect the growing equality of attitude developing among males and females towards computer-supported learning. The inclusion of self-tests and amount of support students received through the packages' integration within the modules may also have contributed to these findings.

Course group comparison

In a previous study medical students developed more negative post-use attitudes towards similar web-based learning materials than sociology students did (Vuorela & Nummenmaa 2004). The course groups of students using the Movement Analysis, Manual Therapy and Stroke packages were therefore compared to investigate whether variations in opinions existed between them. Significant differences in opinion between course groups would necessitate more tailoring of the materials to the

requirements of these course groups rather than using the same computer-based materials across courses. It was hoped that because the materials had been designed to support similar learning outcomes for all course groups that the packages would be equally applicable to all course groups.

Generally all course groups evaluating the packages were equally positive in their attitudes and opinions. No significant differences in opinion or attitudes were found between the 6 course groups evaluating the Movement Analysis package. Attitudes across all groups were largely positive. MSc (pre-reg.) Physiotherapy (intake 2002) and BSc (Hons) Physiotherapy (intake 2003) were the only groups to express any strong disagreement and this was not significant. Significant differences were found in relation to the Stroke and Manual Therapy packages for the MSc (pre-reg.) Physiotherapy (intake 2004) students. These differences, their possible causes and implications are discussed in the next sections.

The Manual Therapy package was evaluated by two groups of physiotherapy students. Most students in both course groups tended to agree with positive statements about the package. However BSc (Hons) Physiotherapy (intake 2003) students were significantly more likely to agree that they enjoyed using the Manual Therapy package than MSc (pre-reg.) Physiotherapy (intake 2004) students. The Stroke package produced a similar variation in opinions. Significant differences were found for several features which were less valued by MSc (pre-reg.) Physiotherapy (intake 2004) than the other two groups of students, BSc (Hons) Occupational Therapy (intake 2003) and BSc (Hons) Physiotherapy students (intake 2003). MSc (pre-reg.) Physiotherapy (intake 2004) students were more likely to disagree with BSc

Occupational Therapy (intake 2003) students that the Stroke packages helped them to learn (p=0.009). They were significantly more likely to disagree that the Stroke package was enjoyable (p=0.008) and the videos supported their learning (p=0.015) than BSc (Hons) Physiotherapy students (intake 2003). This group of MSc students was also more likely to disagree that time spent using the package was worth it, the Stroke package was a useful resource and they felt more confident towards computer assisted study materials than both other groups of students. There were no significant differences in attitudes between the BSc (Hons) Physiotherapy and Occupational Therapy (intake 2003) students for the Stroke package.

Students from the MSc (pre-reg.) Physiotherapy (intake 2004) were certainly more negative than the other groups in their views regarding the Stroke package and in their enjoyment of the Manual Therapy package. Vuorela et al (2004) also found differences in attitudes between different course groups using web-based learning. They suggested the reason for the more negative attitudes exhibited by one group was due to facilitation of this group by a less experienced tutor. This was not the case for the R.G.U. students evaluating the Stroke and Manual Therapy packages. The introductory and evaluative sessions were conducted in all cases by the investigator, and the core neurology modules teaching teams remained the same for all groups using the Stroke package. Lack of variation in the neurology modules teaching teams should contribute to more consistency of learning experience for the three groups of students. However some of the teaching for the BSc (Hons) courses was shared between Physiotherapy and Occupational therapy students which may have promoted more positive attitudes to the subject generally in these students. To try to identify other reasons for these differences, the module and course evaluations for these

groups of students were examined. These evaluations revealed that the MSc (pre-reg.) Physiotherapy (intake 2004) group had given many aspects of their course and modules negative evaluations. The main problems these students identified related to last minute timetable changes and module organisation. They were generally very negative about the course as a whole.

"Workload inconsistent and poorly timetabled. At times there were gaps in the semester were workloads were low and towards a placement or an event the workload would increase vastly."

"The organisation of timetabled lectures and practical classes also needs to be refined."

"It appeared that the organisation of the course suffered with the intake of a larger number of students in the year below, as from their start date it seemed that aspects of the course were disorganised."

(MSc (pre-registration) Physiotherapy intake 2004 Module Evaluation R.G.U.)

Staff problems contributed to these organisational issues, but these have now been resolved and most of the problems addressed. It is interesting to note that these students did not complain or make negative comments about the computer-based learning components in their module or course evaluations. It is thought that the students' generally negative feelings at the time contributed to their more negative evaluations of the packages than the other groups. This study did not include analysis of information from the module and course evaluations, as a specific package evaluation was designed. It may be useful in further studies to compare specific

package evaluations with overall module and course evaluations to allow more depth of information and analysis about the experiences of particular course groups, possibly affecting their perceptions.

Despite these anomalous differences in attitudes from one course group, it is reassuring that there were no other significant differences found between all the other groups evaluating the packages. It is particularly encouraging that the BSc (Hons) Occupational Therapy and Physiotherapy (intake 2003) groups did not differ in their opinions of the Stroke package, as they shared the teaching for this module. There were concerns that their opinions would differ due to the fact that no specific occupational therapy component had been included, and some comments from the occupational therapy group relating to the package did indeed suggest a bias towards physiotherapy. Despite this it is still considered necessary to incorporate multi-professional components into this package. This will better reflect clinical practice with this client group as previously discussed (Barnes 2003).

Package Comparison

Design features of each package were slightly different as advances in technology were incorporated into the development of each. Consequently as the Stroke package was the more recently developed it was thought that features such as access, feedback and navigation may be more positively valued by students evaluating this package. To determine whether this was the case attitudes to features and open answers for the three packages were compared.

Some groups had to be excluded from statistical comparison between the packages. Students in these groups had evaluated more than one packages and therefore should have been compared using a between subjects test. This type of test requires the ability to match the data for each student across their evaluations of the packages but as evaluations were conducted anonymously this was not possible. It was felt that maintaining anonymity of the evaluations took priority as this would help to ensure more honest opinions were given by the students (Cohen et al 2000).

Students evaluating all three packages mostly agreed with common positive statements about features of the packages. All packages elicited similar proportions of positive, equivocal and negative open comments. Eighty percent of comments about how the packages had affected students' general knowledge were positive, as were 77% of comment relating to the packages' effects on understanding and 89% relating to the packages' effects on application of knowledge. The Stroke package elicited no strong disagreement with any positive statements about features, and also elicited the highest proportions of strong agreement for most features. Students evaluating the Manual Therapy package exhibited significantly more disagreement ($p=0.01$) regarding clarity of instructions for using the package than those evaluating the Stroke package. It is therefore evident that the format of the Stroke package provides the optimal design for these self-study materials. Students evaluating the Stroke package exhibited significantly more strong agreement regarding the contribution of the videos to their learning than those evaluating the Movement Analysis package did although students evaluating the Manual Therapy package also had positive attitudes towards the video clips. Significantly strong positive attitudes towards the videos in the Stroke

package may be due to the depiction of a real patient with this condition rather than having to imagine how the features of the condition would present. The findings do not necessarily indicate that the video clips in the Manual Therapy package were of less value as students were reviewing techniques they had already seen in practical classes. It is still a valuable use of the technology to allow students multiple exposure to these images to re-enforce their learning (Spiro et al. 1992).

Students evaluating the Manual Therapy and Stroke packages were also asked to reflect on the learning experience, and 79% of students described this as positive. Students related positive learning experiences to self-assessment and feedback for the Manual Therapy package and the video clips for the stroke package.

Students identified different features of the packages as contributing to their general knowledge. Revision and re-enforcement of knowledge was identified most commonly as the package feature contributing to positively affecting general knowledge of movement analysis. Self-assessment and feedback were the package features most commonly identified as positively affecting general knowledge and understanding of manual therapy. The video clips were the package features most commonly identified as positively affecting general knowledge and understanding of stroke. For all packages, the factor most commonly identified as positively contributing to the application of learning was their relevance to work-based / clinical activities.

Although there were relatively few equivocal or negative comments regarding the packages' effects on general knowledge, understanding and application, they tended

to be general. Students evaluating the Movement Analysis package also mostly suggested lack of use as a contributing factor in limiting their understanding.

Pure acquisition of knowledge is associated with superficial learning. Ellington & Earl (1996) and Entwistle et al (2000) recommend trying to facilitate deep rather than superficial learning. Self-assessment has been suggested as a useful method for facilitating deeper approaches to learning (Jones & Kember 1994; Ward 1998). Relating different areas of knowledge has also been identified as an important difference between deep and surface learners (Marton & Saljo 1976). Students' identification of these features as positively affecting their learning with the Movement Analysis and Manual Therapy packages suggests that a deep approach to learning with this material has been achieved. Nevertheless, as Ward (1998) found, it is not clear whether it is the materials themselves which are facilitating this approach or whether the students are those who would tend to adopt a deep approach regardless.

It is unsurprising that the feature identified as providing the greatest contribution to learning for the stroke package was the video clips. It was anticipated that the development of the stroke package would, most importantly, allow students to visualise the clinical features, assessment and treatment of Stroke. Though visualisation of normal functional movements and manual therapy techniques were also developmental objectives of the Movement Analysis and Manual Therapy packages (respectively), students studying these subjects also have access to these visualisations in practical classes within the modules. Most students studying the neurology module will not have seen a stroke patient, for reasons described in the

chapter on development of the Stroke package. The Stroke package not only provides this opportunity, but also provides continual easy access to review the dynamic visual features of this type of patient during the course of the teaching. The value placed by students on this visualisation suggests that the provision of packages containing clips of other conditions may also be of benefit for their learning; with students suggesting this themselves. It might be thought that it would be enough to provide a videodisc or tape of different patients rather than embed the videos within a self-assessment package, but these resources would have to be held in a library, and administered to students. Basing the clips on the VLE allowed easy use and access to the clips and this was also valued by students. One could provide this ease of access to the clips by purely basing the video clips in the VLE without any related questions. A comparison was not carried out to see if this delivery mode would have elicited the same positive attitudes as the complete package. However, it is well established in the literature that the inclusion of self-assessment enhances the learning experience (Cennamo & Dawley 1995; Ellington & Earl 1996; Entwistle et al 2000; Percival et al 1993; Race 1994; Rowntree 1990; Schuttenberg 1984; Ward 1998). Interactive video clips, integrated with other course materials, have been shown by Zhang et al. (2006) to promote higher learning performance and satisfaction than non-interactive video, no video and traditional lectures.

Age groups, genders and course groups of students did not differ greatly in their attitudes towards different features of the packages. The main difference found was the more negative attitudes of the MSc (pre-reg.) Physiotherapy (intake 2004) towards the Manual Therapy and Stroke packages, and reasons for this have already been discussed. The Stroke package compared significantly more favourably in terms of

clarity of instructions and benefits of the video clips. As the Stroke package was the more recent of the packages to be developed and evaluated it is therefore perhaps unsurprising that this package seemed to elicit the most positive feedback and performance from students. These findings are promising as the purpose of the study was to provide self-study packages to supplement students learning and their evaluation should provide information contributing to their further development ad effectiveness (Draper et al. 1996). This suggests that further packages of this nature should be developed to enhance students learning experiences.

This section describes the students' reported effects of the packages on their learning. To discover actual effects on learning, student behaviour with the packages and scores achieved in self-study and test versions were compared and correlations analysed. This could only be achieved with packages where tracking data was available, the Manual Therapy and Stroke packages. Analysis of this tracking data provides information about whether learning improved with use of the packages. This data also contributes to confirming whether further package development of this nature should take place. The views of students are also compared in relation to the different options for delivery of the subjects supported by the computer-based self-study packages.

Students' preferences in relation to types of delivery for Movement Analysis, Manual Therapy and Stroke.

The favoured method of delivery for all subjects was the practical class. This was particularly so for students evaluating the Manual Therapy package, as they differed highly significantly from students evaluating the Movement Analysis package ($p=0.004$) and the Stroke package ($p< 0.01$) in the proportion of students' top rating this delivery method. It is unsurprising that students rated practical classes so highly for studying Manual Therapy, as it is a subject which requires the physical, practical application of manual techniques. The web-based packages were never intended to replace the conventional teaching of these subjects, but to provide another method of self-study to support this. Students evaluating all the packages, on average, ranked web-based delivery third after face to face instruction. All students rated paper-based learning as their least favoured form of study across subjects. It is probable that before these packages were provided, student self-study would have consisted of the traditional paper-based activities of reading and making notes. Negativity towards this type of paper-based study could de-motivate students towards self-study activities, which have been identified as important to the learning process (Rowntree 1990). Acceptability of web-based learning as a better alternative to paper-based study supports the need for continued package use and development to continue to support and motivate self-study in these subjects. Research on learning styles of students suggests that a variety of learning styles should be catered for rather than trying to match learning styles with delivery methods (Bonham 1988). Continued provision of these packages will provide an acceptable vehicle for a different method of study to be employed by students and cater for wider range of learning styles than traditional methods alone.

Face-to-face teaching was most commonly ranked second. Students seem to prefer delivery methods with direct involvement from the tutor, as there is the option to ask questions to clarify understanding. Other investigators recognise the potential for students to feel isolated when using computer-based learning (Dewhurst et al 2000; Richardson 2001). Dewhurst et al (2000) suggest that if computer-based materials are used to replace conventional teaching, then back up tutorials should be offered. They suggest that students may be more accepting of computer based learning if they know tutor support is available even if they choose not to make use of it. An on-line discussion group was available to the students as a help-line, but was minimally used. Students may not have made use of this back-up facility as they were also receiving their usual lectures and tutorials within the module, and may have felt able to discuss issues with the module teaching staff in this forum. It is possible that this question prompted students to consider the possibility that some of their conventional practical and face-to-face sessions might well be replaced with computer-based materials if they ranked these too highly, although this was never suggested. The subjects supported by these packages will always continue to require practical sessions, as students need the opportunity to develop their kinaesthetic and behavioural skills to prepare them for clinical practice. It is possible that in the future, if distance learning components are required within postgraduate courses for continuing professional development (CPD), that some face-to-face lectures could be replaced by on-line activities. These may include the use of videoconferencing lectures allowing students at different sites to interact with a lecturer who could be anywhere a web-cam is available. Students may also be directed to study independently with on-line self-assessment activities allowing confirmation that learning outcomes have been

achieved or identification of areas requiring further study. It is therefore important for students to become familiar with on-line learning activities in order to alleviate anxiety with this form of learning so that they are more prepared for lifelong learning and CPD, which is increasingly making use of this technology.

The CD-ROM method of delivery tended to be ranked fourth by the majority of students. During the early stages of evaluation some students suggested the packages should be delivered via CD-ROM. It is a reflection on the recent improvements in broadband access and university computing systems that web-based learning is now preferred to this form of delivery. The main advantage of a web-based platform for these types of packages is that they can be regularly improved and updated. Another benefit is in the ability of certain assessment systems to employ tracking of students' use. Previous studies evaluating computer-based learning packages (Buchowski et al. 2002; Kohlmeier et al 2000) have relied on submission of students' self-reported use on floppy disc. This information is highly unreliable, as students may well report more use than actually occurred in order to please their tutors. The study conducted by Kohlmeier et al (2000) reported only 67% of the returned discs to have readable files. As tracking facilities improve, this data can be used to develop a greater understanding of how students use these materials and how they best contribute to the learning process. The next section will discuss the results of the tracking data collected in this study.

Students' activity with the Manual Therapy and Stroke packages

A total of 58 students used the self-study version of the Manual Therapy package. The number of attempts at using the Manual Therapy package ranged from one to nine,

with the average number being three. The amount of time spent using the Manual Therapy package ranged from nine minutes to almost four hours. The average amount of time spent by students using the Manual Therapy package was 43 minutes.

The different sections of the Stroke package are considered as separate packages but overall the number of attempts ranged from one to eight. The average time spent on each section ranging from 15 to 30 minutes with the first section of the package being most commonly accessed. It is likely that students tended to access this section first even though they were instructed to access the different sections, as they felt appropriate.

The number of attempts and time spent using the Manual Therapy package is disappointing, as students taking the related module are advised to complete 50 hours of self study on the BSc (Hons) Physiotherapy course and 90 hours self study on the MSc (re-reg.) Physiotherapy course (Robert Gordon University 2006). These results are even more disappointing for the Stroke package. Students taking the related module are similarly advised to complete 50 hours of self study on the BSc (Hons) Physiotherapy and Occupational Therapy course, and 90 hours of self study on the MSc (re-reg.) Physiotherapy course (Robert Gordon University 2006).

These findings are perplexing given that the student evaluations were so positive for both of these packages. It is possible that some students accessing the package did not submit their self-test answers so are recorded as unfinished. These students could not be counted in the study data, as their results were incomplete. Feedback is withheld until answers have been submitted which should encourage students to submit their

answers. Students using the Stroke package reported that the feature they most valued was the video clips. Access levels may appear relatively lower for this package as students may be using the package just to look at the clips without completing any of the questions and thus not perceiving the need for feedback. Students may also have chosen to work on the self-study packages in small groups, but the tracking facility would record this as one student. Students were not required to use individual log-ins for the self-study packages to avoid them feeling that their privacy was being invaded; they were however asked to volunteer their matriculation number as an initial question. Most students using the package entered their number, and there were less than five unrecognisable records recorded for each package that were excluded form the data.

Some of the reasons given by students in their equivocal and negative open comments related to lack of use due to an already full timetable. Students' timetables are constructed with study time in mind and this perception possibly reflects an inability of some students to organise and prioritise their time effectively. Recommended access times and a study plan could be included in the instructions of each package. It should be made clear, however, that these are guidelines and that students may adopt a flexible approach to learning to encourage responsibility for their own learning (Knowles 2000). Students could use the guidelines to identify whether they are meeting the required amounts of self-study and allow further support for students who identify a problem in completing the recommended amount of self-study.

It may be that some students accessed packages once, to diagnose gaps in their knowledge and, although appreciative of the design and features, decided that they preferred another method of study. Nevertheless, only two students evaluating the Manual Therapy package and four students using the Stroke package declared that they preferred another method of study.

Following the module, the BSc (Hons) Physiotherapy students asked for all the packages to be made available for their year outwith the module link in the VLE. The students had identified that they may be useful for revision before and during their clinical placements. It may be that students only recognised the need for further self-study in these areas after completion of the module, when they had received their summative assessment grades, or were more motivated by the prospect of being questioned on these subjects and demonstrating their practical skills on clinical placement. Fourteen percent of the positive comments made by students using both the Manual Therapy and Stroke packages made reference to their relevance to clinical/work based activities. Seale et al (2000) investigated the motivational effects of assessment in Physiotherapy and Occupational Therapy students, and found that motivational features of assessments included the relevance of the assessment. Students identified two clinical placements as two out of the three most motivational assessments. Continued provision of the packages to students once they have completed the modules for use before and during clinical placements may show a change in the amount of access, which would be worthy of further investigation.

The Manual Therapy and Stroke tests were not summatively linked to the module mark, and this could also have had a de-motivating influence on students' use of the packages. As one student commented:

"It was added pressure, the score doesn't even go towards our final grade for second year."

(BSc (Hons) Physiotherapy)

This statement reveals evidence of a strategic approach to learning which has been described by Entwistle (2000). This approach is taken by students who strive to achieve to meet the assessment requirements of the course through their learning activities rather than a deep approach taken by students who have a desire to really understand the subject regardless of the assessment. It is particularly important in vocational courses that students do not compartmentalise their learning by purely focussing on passing the module assessment. Students adopting a deeper approach by seeking to thoroughly understand the subject may be more able to transfer and apply their knowledge to new situations such as clinical placement. To encourage self-study in students adopting a strategic approach, and facilitate deeper learning, use could be made of mandatory tests relating to self-study activities. El Tigi (2000) also suggests that a lack of mandatory use could be responsible for decreased motivation she found in students using course web sites.

Students on the MSc (re-reg.) Physiotherapy course are required to complete module portfolios as a record is of the different learning activities they have successfully completed during each module. They are also required to reflect on these activities. MSc (re-reg.) Physiotherapy students evaluating the Manual Therapy and Stroke packages were required to submit a report of their successful completion of the test version for their portfolios, although this did not contribute to their overall module mark. It would be useful to discover if these students used the packages more than students did who were not required to submit their successful test versions. If this was

indeed the case submission of a successful test version of the package with reflection on the learning activity may provide a motivating influence to increase use of the self-study version as well as proving a useful learning exercise in itself. Reflective practice is considered important to develop deeper learning and higher-cognitive skills. Its use is currently being actively promoted within CPD activity required by Allied Health Professionals in order to demonstrate updating of skills required for these professionals to continue to be registered to practice (The Chartered Society of Physiotherapy 2003).

Lack of use of the packages may also be due to students' inability to identify an obvious relationship between the self-study materials and the assessed course work and Objective Structured Practical Examination (OSPE) for both subjects because the format of assessment differs. Some students using the Movement Analysis package gave the link between the self-study package and the summative assessment as a reason for liking the package, but no students in either the Manual Therapy or Stroke evaluations identified this aspect of the packages. Green et al (2003) identified a peak in package multiple-choice-question (MCQ) use immediately prior to the subject examination using similar tracking facilities. It is not reported whether the examination was also in an MCQ format (Green et al. 2003). It was thought that students would particularly benefit from using the packages in preparation for the OSPE and further study of the dates and times of access would allow investigation into whether use does indeed increase before assessment. If package access were extended to support preparation for clinical placement, this could also be monitored. Green et al (2003) that found only about half of the students using the MCQ's accessed the related video clips. They suggest that this could have been due to

technical problems with the clips, in particular when accessing them from home. Students evaluating all three of the packages, currently under investigation, identified some technical problems with accessing the video clips, and this would have negatively affected re-access to the packages after initial use. Now that these technical glitches have been resolved it is expected that access levels will improve.

It was also hoped that the module teaching teams who had been involved in making the videos and reviewing the self-study materials would remind and encourage students to use the packages. Informal feedback from these tutors confirmed that this was indeed being done but tutors were not confident in accessing the packages themselves, which may have led to them being less familiar with their content and operation and thus less able to support students' use during the modules. While staff involved in the modules were enthusiastic about the development and implementation of the packages, it is clear from the tracking information that none of them accessed the packages without supervision from the evaluator. Lack of tutor experience with this type of resource has previously been identified as a possible reason for students' negative attitudes towards web-based learning (Vuorela & Nummenmaa 2004). Staff attitudes to this type of learning and skill gaps must be addressed through adequate training and encouragement in order to allow them to support their students' use of these resources.

It is clear from the amount of access demonstrated by the students that steps need to be taken to encourage increased use of these self-study materials if they are to continue to be developed and extended. This could take the form of more clearly identifying links between the subject material and the practical assessment, and

reminders by module leaders more familiar with the packages to access relevant sections of the packages as topics are addressed through the module. The test version could be incorporated into module portfolios, and access extended to allow preparation for clinical placement. Evaluation should include identification of peak times of use in relation to assessment times and clinical placements.

Comparison of self-study and test scores with attempts and time spent using the packages

Comparison of students' use and scores must again take the small convenience samples used into consideration. Again group sizes and characteristics for students using each package differed and results of the group comparisons should therefore be interpreted with caution as these other variables may be influencing the results. The data is not normally distributed and therefore necessitated the use of less robust non-parametric statistical tests.

Half of the comparisons made for relationships between number of attempts and amount of time spent with self-study and test score showed a positive correlation ($p = 0.29$ to 0.89). Strongest correlations were found between improvement in score and number of attempts for both the Manual Therapy and all sections of the Stroke package it is therefore suggested that the following null hypothesis is rejected:

There is no statistically significant linear relationship between the number of attempts and the students' improvement in self-study score.

It is suggested that the following alternate hypothesis is accepted:

There is a statistically significant linear relationship between the number of attempts and the students' improvement in self-study score.

This relationship was positive in all cases.

There was a positive correlation between improvement in score and time spent for the Manual Therapy package. It is therefore suggested that the following null hypothesis is rejected for the Manual Therapy package:

There is no relationship between the amount of time the student uses the package and the students' improvement in self-study score.

It is suggested that the following alternate hypothesis is accepted:

There is a statistically significant linear relationship between the amount of time the student uses the Manual therapy package and the students' improvement in self-study score.

This relationship was positive in all cases.

Only two out of the four sections of the Stroke package showed statistically significant correlations between improvement in score and time spent this would suggest that the null hypothesis cannot be rejected i.e.

There is no statistically significant linear relationship between the amount of time the student uses the Stroke package and the students' improvement in self-study score.

There were no statistically significant correlations between test score and either time spent or number of attempts for the Manual Therapy package and only one section in each of the section of the Stroke package showed significant correlations. Therefore the null hypothesis cannot be rejected for either the Manual Therapy or Stroke packages i.e.

There is no statistically significant linear relationship between the amount of time the student uses the package and the students' summative test score.

There is no statistically significant linear relationship between the number of attempts and the students' summative test score.

All significant correlations were positive. Positive correlations for improvement in self study score and number of attempts suggest that the more times students accessed the packages the better they became at answering the questions. This could mean that students were rote learning the answers to the questions after receiving feedback. While this may have occurred to some extent it is unlikely to have made a major contribution to improvement in score due to the complexity and extent of the content.

There were also positive correlations for time spent and improvement in self-study score in most packages. This would again suggest a positive effect of the package on learning, however this could also be attributed to students taking more time to rote learn their feedback. Correlations for time spent compared with self-study score are not as strong which may suggest students are not spending a long time learning the answers to the questions. It is likely that students are accessing the self-study packages and completing only those questions they feel they need or want to, therefore taking less time.

The tracking facility calculates the percentage score out of the total mark available rather than out of those answered, which will penalise those students who decided to complete only a proportion of the questions. A more in-depth analysis of time spent on each attempt and number of questions answered would give a clearer picture of the patterns students adopted while using the packages to study and this should be considered for further research. It may be of benefit to discover whether adjustments

to the tracking facility can be made to allow percentage scores to be calculated from those questions answered as well as the total score available.

It is disappointing that only two sections of the Stroke package showed a significant positive correlation between time spent or attempts compared to the test score. If a stronger relationship between these variables had been found it would suggest that there was transfer of learning from the self-study version to the test version. Assumptions from this data about the effect of the self study package on test score are not totally justified as the students were also receiving conventional teaching on the subjects, which would contribute to their knowledge and understanding of the subject. The test itself could also have affected the correlation although care was taken to ensure similarity with the self-study question format and relevance of the questions in relation to the module and self study materials. The Stroke test was not normally distributed. The range (41-100%) and mean mark (77%) for the Stroke test were quite high with all students passing the test. This does indeed suggest that the test did not challenge students enough. The Manual Therapy test results were normally distributed and the range (14-77%) and mean (50%) suggest that this test was appropriate to test the students' knowledge of the subject. Further in depth analysis of test items with larger numbers of students would allow any rogue questions to be identified and the test to be adjusted accordingly.

Analysing the results of the module assessment in relation to use of the self-study materials could provide further information to support correlations with test score and transfer of learning. The module assessments include written coursework testing higher cognitive learning outcomes of the module such as discussion and justification

of treatment choices. This was not the purpose of the current self-study packages, as e-learning materials of this nature require students to undertake more discursive activities. The provision of discursive on-line resources may be useful for facilitating this type of learning in distance learning environments but on campus tutorials and workshops fulfil this requirement. Practical assessments (OSPE) are used to assess the learning outcomes more closely associated with the self-study packages. These assessments are graded as pass or fail and it was felt that this measure would not be sensitive enough to detect correlations with number of attempts and time spent using the packages.

The package exhibiting most positive correlations was the first section of the Stroke package this would seem to suggest that this package was most effective in facilitating learning. However the highest number of students used this section of the Stroke package. Less significant correlations are demonstrated for those packages accessed by only a few students, and therefore continued evaluation of this nature with a larger sample size will be required to demonstrate meaningful differences. Sample sizes required to provide statistically significant correlations between those variable where correlations were not significant may be calculated from statistical tables (Fisher & Yates 1974).

These early results are encouraging as significant correlations were found between package use and effect on learning, all of which were positive. It is difficult to make comparisons between these results and those of other researchers as very little research has been carried out using tracking of student use. Ward (1998) used log-in data to compare students' activity with different e-learning materials to their learning

styles. He also found self-assessment use disappointing. Students who were deep learners tended to use the self-assessment tests more than those who were surface learners did. Subsequently he found a tendency for those who were deep learners to score better in their test than those who were not. It remains difficult to say whether this was a positive effect of the e-learning materials or just due to them being used more by those who were more able students. This may also be the case in relation to the positive correlations found in this study but if all types of learners can be motivated to use computer-based self-study and assessment more then improved long-term results may be seen. It must be remembered that these results are not transferable to similar materials used in other courses but apply only to the packages investigated supplementing these modules.

In summary the tracking data suggests that continued use of the self-study packages promotes learning of the subjects they support. Further research with larger samples is required to determine how access levels can be improved and whether a relationship does indeed exist between use of the packages and transfer of learning to a test version of the package. A more in-depth analysis of the tracking data may allow a greater understanding of how students use the packages to achieve the greatest effects on learning. This information will allow further optimum development, integration and implementation of the packages.

Recommendations for Further Developments and Future research

Methodological developments

Overall it is felt that the method employed was appropriate to achieve the aims of the study and where possible steps were taken to control for extraneous effects influencing the data. It is felt that some conclusions can be drawn from the results in relation to students' attitudes and use of the packages but that future studies should refine this method to allow a deeper understanding of this and firmer conclusions to be made. Ideally comparative studies should have a large representative population and be subject to a randomised-controlled trial. Randomisation eliminates bias and equalises known and unknown prognostic variables such as previous educational experience. It can also provide a baseline for statistical testing by equalising groups. Half of the randomised participants would be protected from any unforeseen adverse effects of the intervention being tested. Randomisation in this type of study may not be expedient in terms of time as technology advances so quickly that to maintain a controlled state for a period required to generate a large enough sample technology could overtake the packages being tested. Students may volunteer to take part in the trial because they are keen to use the new technology but they may become displeased if assigned to the control group and thus withdraw from the trial affecting equity and comparison of the groups. It would be practically impossible to ensure that the control group remained unexposed to the computer-based versions of the self-study packages. If students in the control group decided they wanted to access the packages it would be impossible to control this even with geographical isolation, as they are web-based. Passwords would not guarantee exclusivity of use either as these can easily be shared. As previously stated the aim of this evaluation was not to compare packages to

traditional self-study methods but to evaluate whether they had achieved their desired objectives.

Attitudes and confidence with computer based activities should be compared before and following package use to determine effects of the package on these. It would be interesting to know whether students who are more positive are also those who are more confident and whether in turn this affects how students use the packages. In order to compare these variables one would need to be able to link the evaluation form to the individual using the computer's tracking data. This may mean a lack of anonymity in the evaluation influencing the honesty of students' responses to the questionnaire if they thought their tutor was able to identify their comments. This could be overcome in future studies by using different investigators to administer and analyse the questionnaires who are blind to the identification numbers of students. This would also enable between subject comparisons to be made for the same students using different packages.

As previously identified the use of small convenience samples meant that data was not normally distributed and non-parametric tests had to be employed in statistical comparisons. These samples are not necessarily representative of the larger population and use of the packages in other universities may produce different results. The packages however were designed with the learning outcomes of the courses at Robert Gordon University in mind. Lewis et al (2001) suggest that the ultimate judgement of the efficacy of computer based packages is how well they meet their intended objectives and the results of the study suggest that they meet their development objectives and the needs of these courses. Samples sizes could be

increased through the continued evaluation of the packages with successive groups of students on these courses. It would however be valuable and interesting to discover whether the packages were also of use to other similar courses in different universities. A multi-centre evaluation would further increase the sample size and allow valuable comparisons to be made between similar groups of students, allowing results to be generalised to the larger population of health science students.

Ward (1998) was able to discover which components of his computer based resources were most used. This was possible to a certain extent with the Stroke package as it was constructed in separate sections but future package developments should take this into consideration. It was felt that numbering the sections may have led students into thinking they had to complete them in order thus contributing to less access in sections three and four as students possibly felt it was too time consuming. If use is to be made of sections clear instructions should be provided on-line to students on their navigation.

Further use could be made of tracking information and investigations should be made into the possibility of calculating percentage scores based on the number of questions answered to allow more detailed interpretations of student use to be made. Comparisons of student use with the test scores were disappointing this may be due to a flaw in the test itself, a question item analysis could now be carried out following use by these first groups of students in order to refine and improve the test questions. Sample sizes could be improved by motivating students to use the packages more through compulsory post-testing which could provide a vehicle for reflection and inclusion in module portfolios.

Problems with the technology arose in earlier development and implementations of the packages, in particular regarding the ability of the students to play the video clips. This was due to the incompatibility of students' computers with the streaming server providing the video clips. Conole et al (1999) suggest preparing a shortlist of requirements for implementing the use of information technology in learning and comparing this to local factors affecting the media's use in terms of opportunities and hindrances. However it was thought that possible hindrances and barriers had been explored. The capabilities for using streamed video existed within the university in theory but the incompatibilities were not discovered until the clips were put into practice. The use of this technology highlighted the existence of the problem and this has since been rectified. This highlights the importance of communication between university departments when changing specifications and upgrading equipment, as incompatibility may have an effect on the quality of teaching and learning. It is important that the views and experiences of teaching staff are taken into account when deciding on structural changes. Link et al (2000) also highlight the problems created by lack of consultation with those using these technologies and says that educators should have a voice in the development of technology plans including allocation of funds for maintenance and upgrading of hardware and software. Recent up grading of the internal VLE at Robert Gordon University took into account the results of a staff survey of tutors' opinions and needs and interested staff were co-opted on to the development committee. This not only helps the smooth running of teaching and learning initiatives using information technology but also makes those staff involved in these innovations feel their work is valued and contributes to future improvements.

Extension and development of further packages

The packages continue to be integrated and used within the modules they were designed to support. Improvements are being made to all the packages as previously suggested by the results of this evaluation. The Movement Analysis package is being transferred to the Questionmark Perception format similar to the Stroke package. The Manual Therapy package is being updated in terms of instructions for use, navigation and changing clinical practice. Test versions of the packages are being developed to ensure question validity and difficulty and these are now incorporated into module portfolios for all groups of students using the packages. Questionmark Perception versions of the Movement Analysis package have been developed specifically for the BSc (Hons) Sports and Exercise course and used as the summative module assessment in conjunction with self-study.

The need for extension of existing packages and development of further packages similar to the Stroke package has been identified. The students expressed the value of the videos in all packages. Seymour (1998) found that physiotherapy students developed greater agreement with "master clinicians" in gait analysis when instruction was supplemented with video rather than descriptive or by viewing the patient in real time. Incorporation of this skill into an extended version of the Movement Analysis package would make further use of this valuable resource. The VICON motion analysis system would provide animated clips, biometrics, kinematic data and graphs of different gait patterns allowing students access to practice of this skill within the Movement Analysis package. The animation facility of the VICON

system would also allow patient anonymity to be maintained possibly increasing the number of likely patient volunteers.

Evaluation should be continued to ensure that these new and extended packages facilitate required learning and that development objectives are being met.

The packages were designed for use with first and second year students, those designed for second years were intended to facilitate slightly higher level learning outcomes than those for first year. Information from the open questions suggests that they facilitated learning by developing their knowledge and applying this knowledge through testing their understanding. Mayes (1997) describes 3 levels of a conceptualisation cycle relating to the development of students learning levels. The packages would support learning in the first conceptualisation phase of this cycle by exposing students to knowledge and concepts. Application of this knowledge allows students to progress to the second construction stage, which also seems to occur through package use. The third stage involves students being able to test their knowledge and receive feedback allowing erroneous concepts to be resolved. This is called the dialogue stage and Mayes suggests that it be facilitated through discussion with tutors. Although the Manual Therapy package tested students' knowledge of these techniques it is through using the videos to support increased practice of these techniques that application of their knowledge can be furthered. Feedback on their abilities to carry out these techniques is then provided through practical classes in the presence of the tutor. The Movement Analysis and Stroke packages require students to interpret the visual information and solve observational problems while receiving

feedback, thus possibly facilitating all three stages of this cycle even though dialogue is taking place with the computer materials.

The computer-based study materials could be developed to further increase facilitation of the dialogue stage by using on-line communications such as discussion forums where students are given follow up activities relating to the earlier packages requiring group work and discussions with tutors. In the case of the Stroke package this could take the form of suggesting how the patient's treatment could be progressed and justifying treatment choices. As it is likely that treatment choices would vary between groups this task provides a good basis for discussion of possible options and other considerations. This type of activity could easily be used to extend the packages and integrated into the relevant modules later in the course which demand revisiting of prior learning but extending and deepening of students learning through higher level learning activities requiring critical analysis and synthesis of ideas. Using these basic packages in earlier stages of the course may well allow the dialogue stage to occur by acting as a catalyst for this discussion.

The packages were fully integrated into the modules they supported and it was intended that reference be made to them through the modules by the teaching team at relevant points in the teaching process. This did occur to a certain extent. Through informal feedback from colleagues opportunities arose during practical classes for students to raise issues they had covered in the packages. As students had been introduced to the packages early in the module they may have accessed areas they had not yet covered in face to face teaching, enabling students to have a more informed discussion in these sessions. Students then had the opportunity to revisit the package

once it had been covered in class. This use of the packages would allow consolidation of learning. This is a clear advantage of a blended learning approach making use of both traditional and e-learning teaching strategies. This approach does require the tutor to develop certain knowledge and skills. To allow them to direct students to the appropriate sections of the package and answer queries requires a sound knowledge of package content design and purpose. It is therefore vital, in a blended learning environment, that the teaching team is involved in the development of these packages rather than interested tutors and educational technologists introducing them as an add-on component.

Staff training and involvement in future developments of the packages are necessary to facilitate the best uptake and learning environment for continued use and evaluation of the packages. Many staff still use the VLE as a repository for lecture notes and course materials which then have to be downloaded by students. El Tigi (2000) warns against using web-based resources which require students to download and print out large amounts of information as this is de-motivating to their use of these resources. Haigh (2004) suggests that if the VLE is to become more than an "on-line filing cabinet" it is essential that academics develop the skills to use them more effectively. Through involvement with evaluations at the "chalk face" academics may become more aware of approaches which work well and those that don't. This will enable them to produce the best mode of learning for students. Merely providing staff training courses however does not solve the problem of staff not fully engaging with, using and evaluating technological advances in their teaching. Albright (1996) suggests that staff uptake of these technologies is low because innovation in teaching practice is not rewarded by educational funding bodies. Dewhurst & Norris (2003)

also recognise this and add that another reason for lack of staff uptake is too many other constraints on their time. Meyer (2001) suggests solutions to these problems lie in increased support and training but also the provision of an environment which promotes entrepreneurial behaviour and empowerment of lecturing staff.

To facilitate increased uptake and use of the packages by students access could be extended, as they suggested, allowing students to re-visit them before and during clinical placement. This would allow an extended period of time for students to digest the teaching they received during the module. Students learning needs and motivation to re-access the packages would arise from preparation for a clinical placement, they would then be able to test their knowledge in this area and receive feedback, allowing identification of gaps in knowledge. This cycle of events in the learning process fits with Race's ripples model of learning involving the interaction of needing, doing, digesting and feedback (Race 1994). This model for use of the packages could also apply to qualified staff preparing to move to a new clinical area, returning to work after an absence or in the normal process of continuing professional development. If remote access is required preliminary investigations should be carried out to determine if access is feasible from remote sites and hospital computers. The advancing nature of wireless technology and personal digital assistants (PDAs) may help to facilitate remote and portable access.

The packages were time consuming and resource-intensive to produce particularly the patient video. Irrespective of the effectiveness of the packages implementation ultimately depends on cost. This study did not analyse the cost of these resources but was concerned with finding ways to use technologies already available in the

university most effectively. These resources required a substantial initial outlay of funding by universities though upgrading and maintenance costs are relatively low. These resources should therefore be used to best advantage students rather than gathering dust in a virtual cupboard. If elements of these packages could contribute to shared learning objects this would make better use of these valuable resources. Through showing applicability of these types of learning resources to different groups of students commercial gains may be made through the sharing of these resources with other educational establishments. Since initial research has shown these types of packages are useful and effective resources for Health Science students funding for future research and development may be available.

Conclusions

Development

This study aimed to develop web-based e-learning packages to support health science students in self-study. Three packages were developed; video clips of normal movements, manual therapy techniques and a stroke patient were integrated with related self-assessment questions and other relevant course materials through a VLE. Initial package development proved problematic as the technology available was not yet able to meet the demands of open access for multiple users to high quality video clips. Computer applications for creating self-assessment questions were also suffering from early design faults. The format of the packages evolved as technology developed and in relation to the results of the ongoing integrative evaluation. At the outset of the project no other similar learning materials were available for students hence the need for this development. To date the use of streamed multimedia for self-

study materials remains limited, therefore this study is a definitive piece of work making a significant contribution to research in this area.

Evaluation

Integrative evaluation is recommended in the development stages of these types of learning materials but studies employing these methods were not evident in the literature for these types of learning materials. This study used an integrative evaluation; employing different types of evaluative tools to investigate the suitability and acceptability of the learning materials within the real learning environment that they were designed to be used. Thus this study is the first to attempt a systematic integrative evaluation of this type of e-learning. A questionnaire allowed student opinions of the packages to be investigated and compared between groups. Tracking of students' use in the later two packages provided in-depth information about student activity and improvements in learning which were compared for correlation. Some earlier studies had made use of tracking student activity through log-in statistics but this study served as a pilot for the use of more detailed tracking information in evaluating students' activity with computer based learning materials and comparing this to improvements in learning.

Students' attitudes to the packages do not differ greatly between age groups, gender and course groups. This finding differs from those in previous studies and is possibly representative of the growing confidence in all students in using not only computer-based learning materials but also technology in general. The main difference was in the more negative attitudes of the MSc (pre-reg.) Physiotherapy (intake 2004) towards the Manual Therapy and Stroke packages and though this is not considered significant reasons for these differences have been suggested (pages 313-315). Further

evaluations with other cohorts of students from this course will clarify this perception. The questionnaire should be refined to allow inclusion of a statement relating to feedback in the Likert scale evaluating features of the packages. Further depth of information may also be gleaned from conducting structured interviews with students and teaching staff to enable clarification of findings. Evaluation should be extended to include students from other universities in similar courses.

Overall students' attitudes towards most features of the packages and their contribution to learning were very positive. The students, for different reasons, valued all packages. It seems probable that the more students use the package the more their learning is improved but a more challenging test version should be designed to allow investigation of whether students learning with the self study version is transferred to their summative assessment. These early findings are unique in providing evidence for the continued development and use of computer-based self-study materials using multimedia as a high fidelity learning tool for health science students.

Some improvements to the packages are required in terms of feedback, instructions on use and context and access. More consistency in detail and style of feedback will be facilitated by updating all the packages to the newer version of QMP. The use of discussion forums will also be further explored (page 341-342). Clear on-line written instructions for students will be standardised and staff development of module teaching teams undertaken to enable consistent reference to be made to the learning materials in practical classes (page 342-343). Access will be extended to students out with the module to allow investigation of the materials in supporting study prior to clinical placements (page 344).

Extensions to the packages should also be made to include links to other related materials in the case of the Manual Therapy package and more multi-professional components to the Stroke package. The Movement Analysis package should make use of the VICON motion analysis system to provide increased opportunities for students to practice gait analysis. The format of the Stroke package seems to provide the optimum experience for students of the three packages in terms of the features evaluated in the Likert scale.

Further research

Future research should continue to investigate the relationship between different students' attitudes to and confidence with e-learning materials through the use of a refined on-line questionnaire. Research should be extended to investigate the relationship between confidence in e-learning and learning styles to the effectiveness of these materials.

Updating of the packages and further analysis of tracking information should take place to facilitate continued investigation into the relationships between student use of these materials and their effectiveness. Extension of the packages' use to other situations such as pre-clinical placement and with other groups of students, possibly from different universities, should also take place to investigate whether positive attitudes and effectiveness is maintained.

More imaginative use of this environment through improved staff training and involvement in evaluation will increase understanding of components valued by students and provide more varied, technologically relevant and effective learning resources and experiences. Computer and web-based technologies are progressing swiftly and should be harnessed and used to complement and not replace traditional teaching techniques. Whilst initial development cost might be high; this should be

repaid in time by low on going maintenance and updating costs. As portable wireless technology advances the boundaries between campus-based and distance learning will blur creating a truly blended learning environment.

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Appendix 1

ROBERT GORDON UNIVERSITY

INFORMATION SHEET FOR PARTICIPANTS IN THE COMPUTER ASSISTED LEARNING PROJECT

You have been asked to allow the project team to use videos of your activities in the School of Health Sciences at Robert Gordon University. These videos will be included in a computer based learning tool for students in higher education on health related courses. It is hoped that this tool will enable students to learn the skill of analysing clinical problems related to movement by giving them access to a more realistic situation for practice. The extent to which the tool achieves this will also be tested as part of the project. You will have the opportunity to determine which video clips we may use.

. You may refuse to continue with filming at any time and this will not affect the management of your medical condition/ continuing study on your course at R.G.U.

.Any information given with the video will be underwritten with a disclaimer showing that this does not necessarily relate directly to your video clip. Your identity within the project will remain confidential.

Thank you for your interest.

Valerie Cooper
Physiotherapy Lecturer
School of Health Sciences
Robert Gordon University Aberdeen

Appendix 2 Consent to take part in the videos.

Robert Gordon University
School of Health Sciences

(Block Capitals)
Patient / student Name
.....
Address: .....

Postcode: .....
Telephone: .....
Email: .....
Date: .....

Doctor / Consultant:

I hereby confirm that I give consent for the photographs and/or video images and/or sound recordings (the material) to be made of me.

I consent to the material being shown to health sciences staff and students, used in publications, journals and textbooks and used in any other form or medium including all forms of electronic publication or distribution anywhere in the world. All or part of the material may be used in conjunction with other photographs, drawings, videotape images, sound recordings or other forms of illustration. Efforts will be made to conceal my identity but full confidentiality cannot be guaranteed.

I can view the material by arrangement with the Robert Gordon University School of Health Sciences CAL developer. However, once released, I realise that recovery of the material may not be possible. I understand that no fee is payable to me by the Robert Gordon University or any other person in respect of the material either now or in the future.

I confirm that the purpose for which the material would be used has been explained to me in terms that I have understood. **Refusal to consent will in no way affect my medical care**.

To be completed by Parent or Guardian (if patient is under 16)
Please tick the box only if you agree.

☐	I **AGREE** with the above statement	Signature (patient or parent/guardian)

Contact;
Mrs. V. Cooper
Lecturer
School of Health Sciences
Faculty of Health and Social Care

Garthdee Road
Garthdee
Robert Gordon University
Aberdeen AB10 7QG

Tel. 01224 263280
e-mail v.cooper@rgu.ac.uk

Appendix 3
Consent to take part in the Evaluation of the Manual Therapy Computer Self Study Package

The manual therapy self study package has been developed to assist your study of Maitland and McKenzie techniques for spinal rehabilitation. Part of your assessment for this module will be to complete an on-line test of your knowledge in this subject which will form part of your module assessment portfolio. In order to examine the effectiveness of the self study package and inform its further development I require your feedback from the completion of an on-line evaluation form. I also wish to collect information from the package about how it is being used by each student i.e. how often, for how long and access from home and university. This information and the group test scores will be collected and reported anonymously.

I would therefore be very grateful if you would complete the consent form below.

Thank you

Valerie Cooper

Lecturer Health Sciences

I .....(print name)

Course.....

Year.....

consent to complete the on-line evaluation of the Manual Therapy Self Study package. I understand that when using this package information will be collected about its use and that this will be reported anonymously. I also understand that the group results of the on-line test will be reported anonymously to allow evaluation of the effectiveness of the package and its further development.

Signed

.....

Appendix 4
Focus Groups Schedule

Organisation;

Posters up with request for volunteers to take part in the groups with explanation of what they are about (to find out what students opinions of CAL are and how they think we should be developing CAL to best support learning for their course) Refreshments provided. Sort timetabled times when not too busy. Funding for refreshments.

Opening

1. Introduce yourself and tell us what you are hoping we will achieve as a result of this session.

Introductory

2. What aspects of the course do enjoy most/least?
3. Which teaching styles do you find the most helpful e.g. lectures, tutorials, practical, self-study?
4. Do you tend to use the computers much?
5. In what ways do you tend to use them and why?

Transition

1. What aspects of anatomy do you find the most enjoyable?
2. Which aspects do you find difficult?
3. Do you think it is a good idea to support the learning of anatomy with CAL?
4. What other aspects of the course do you think could be supported by CAL?

Key

1. How did you find the anatomy package generally?
2. How do you think it affected your study of anatomy?
3. How did you find you used the package, what prompted or stopped you using it?
4. How did using the package make you feel about CAL in general?
5. Do you have any suggestions for how CAL could be used to support other aspects of the course?

Ending

1. At the end of the day is the anatomy package worth having?

2. What would you say should be the 3 main ways in which we should develop further with the package and CAL in general?

Summarise the main points and ask if there is anything else to add, have we fulfilled the expectations of the group?

Appendix 5 Subordinate hypotheses for each section of the Stroke package

Section 1

Null hypotheses

5. There is no statistically significant linear relationship between the amount of time the student uses section 1 of the Stroke package and the students' summative test score.
6. There is no statistically significant linear relationship between the number of attempts and the students' summative test score.
7. There is no statistically significant linear relationship between the amount of time the student uses section 1 of the Stroke package and the students' improvement in self-study score.
8. There is no statistically significant linear relationship between the number of attempts and the students' improvement in self-study score.

Alternate Hypotheses

1. There is a statistically significant linear relationship between the amount of time the student uses section 1 of the Stroke package and the students' summative test score.
2. There is a statistically significant linear relationship between the number of attempts and the students' summative test score.
3. There is a statistically significant linear relationship between the amount of time the student uses section 1 of the Stroke package and the students' improvement in self-study score.
4. There is a statistically significant linear relationship between the number of attempts and the students' improvement in self-study score.

Section 2

Null hypotheses

1. There is no statistically significant linear relationship between the amount of time the student uses section 2 of the Stroke package and the students' summative test score.
2. There is no statistically significant linear relationship between the number of attempts and the students' summative test score.

3. There is no statistically significant linear relationship between the amount of time the student uses section 2 of the Stroke package and the students' improvement in self-study score.
4. There is no statistically significant linear relationship between the number of attempts and the students' improvement in self-study score.

Alternate Hypotheses

1. There is a statistically significant linear relationship between the amount of time the student uses section 2 of the Stroke package and the students' summative test score.
2. There is a statistically significant linear relationship between the number of attempts and the students' summative test score.
3. There is a statistically significant linear relationship between the amount of time the student uses section 2 of the Stroke package and the students' improvement in self-study score.
4. There is a statistically significant linear relationship between the number of attempts and the students' improvement in self-study score.

Section 3

Null hypotheses

1. There is no statistically significant linear relationship between the amount of time the student uses section 3 of the Stroke package and the students' summative test score.
2. There is no statistically significant linear relationship between the number of attempts and the students' summative test score.
3. There is no statistically significant linear relationship between the amount of time the student uses section 3 of the Stroke package and the students' improvement in self-study score.
4. There is no statistically significant linear relationship between the number of attempts and the students' improvement in self-study score.

Alternate Hypotheses

1. There is a statistically significant linear relationship between the amount of time the student uses section 3 of the Stroke package and the students' summative test score.

2. There is a statistically significant linear relationship between the number of attempts and the students' summative test score.
3. There is a statistically significant linear relationship between the amount of time the student uses section 3 of the Stroke package and the students' improvement in self-study score.
4. There is a statistically significant linear relationship between the number of attempts and the students' improvement in self-study score.

Section 4

Null hypotheses

1. There is no statistically significant linear relationship between the amount of time the student uses section 4 of the Stroke package and the students' summative test score.
2. There is no statistically significant linear relationship between the number of attempts and the students' summative test score.
3. There is no statistically significant linear relationship between the amount of time the student uses section 4 of the Stroke package and the students' improvement in self-study score.
4. There is no statistically significant linear relationship between the number of attempts and the students' improvement in self-study score.

Alternate Hypotheses

1. There is a statistically significant linear relationship between the amount of time the student uses section 4 of the Stroke package and the students' summative test score.
2. There is a statistically significant linear relationship between the number of attempts and the students' summative test score.
3. There is a statistically significant linear relationship between the amount of time the student uses section 4 of the Stroke package and the students' improvement in self-study score.
4. There is a statistically significant linear relationship between the number of attempts and the students' improvement in self-study score.

Appendix 6 Community groups relating to the packages.

A total of 41 students posted messages in the community group related to the movement analysis package. All but one of these students was from the BSc (Hons) Physiotherapy 2002 intake. The other student was from the BSc (Hons) Physiotherapy 2004 intake.

34 of these messages related to the movement analysis package and 7 were not related to the movement analysis package. There were 28 comments about access to the package, many of the comments were positive (10, 29%) but there was concern expressed by most of the students about being able to access the package out-with university and problems with playing the video clips (18, 53%), for example:

"I have just been using the package in the health building and find it very good as a revision aid. But the computers in this building can not currently use the video packages, hope they are fixed soon."

"Still having huge problems with this package. Managed to get video clip for one movement today but not for anymore. How many times do I try before I give up?"

"I have tried this package, and I think it is quite good, but as most people are saying, I think it would be more helpful for revision. I think that having it on a CD ROM would be a very good idea, as people are having such problems with it on the Intranet, and even if you didn't have the Internet, you would still be able to use the package at home."

3 (9%) of the messages were related to confusion about the feedback students received regarding specific analyses, for example:

"Standing from sitting-the knee- (Q2) don't understand how the knee is more flexed in the intermediate position?"

3 (9%) were suggestions made for further developments.

These suggestions were:

"I think that a feedback box would be very useful with a detailed explanation of the answer. I have found that even when the answer is revealed it is not always possible to understand it."

"I think the package should include some stuff on gait analysis if it doesn't already, just so we can get used to it and replay it until we can do it with out the patient having to walk more than once in preparation for placement. Maybe it could include some gait pathologies that we could identify."

"An idea for the movement package, what about a computer generated image of each muscle in action as well as the video work."

"After viewing the video, what about being able to just view the muscles in action about a skeletal frame. That way you could take what you see in real life and compare it with and image of the actual muscles that produce the work. Giving a better of understanding of how they're working to produce the movement, even it its only a little muscle work."

There were no messages from students submitted to either of the other community groups relating to the manual therapy package or the stroke package.

Appendix 7

Movement Analysis Package Evaluation Questionnaire

(This document is a copy of the questions from the on-line version of the form and as such does not contain the response boxes, for the original version of the form please go to the web site in the methods chapter.)

Evaluation of the movement analysis package is an important quality assurance tool which will ensure that the package meets your requirements. To this end, we would be grateful for your assistance in completing the evaluation form. Thank you.

1 of 32

Please select your course from the drop down list:

BSc Hons Physiotherapy

MSc (pre-registration) Physiotherapy

BSc Hons Occupational Therapy

BSc Hons Sports and Exercise Science

If other please clarify:

2 of 32

Select your current year:

1st

2nd

3rd

4th

Other

3of 32

What is your gender?

Male

Female

4 of 32

Which age group are you?

27 or under

28 or over

The following questions relate to your general feelings about using computers. Please rate how much you agree/disgaree with each statement.

5 of 32

Given a little time anybody could learn to use a computer.

Strongly agree, agree, disagree, strongly disagree.

6 of 32

I find a computer difficult to use.

Strongly agree, agree, disagree, strongly disagree.

7 of 32

Computers isolate you from other people.

Strongly agree, agree, disagree, strongly disagree.

8 of 32

I think computer literacy will make me more employable.

Strongly agree, agree, disagree, strongly disagree.

9 of 32

I am afraid of looking silly of I make a mistake while using the computer.

Strongly agree, agree, disagree, strongly disagree.

10 of 32

Please indicate by selecting the relevant option, how confident you feel about the following:

Very confident, Confident, Some confidence, Little confidence, No confidence.

Using web browsers such as internet explorer

Navigating materials on-line

Reading materials on-line

Using multimedia e.g. video clips

Working independently at a computer

Using computers for self-study

The following questions relate to your use of the Movement Analysis Package.

Please rate how much you agree/disagree with each statement.

11 of 32

It is clear what options are open to you at each stage.

Strongly agree, agree, disagree, strongly disagree.

12 of 32

It is easy to navigate where you want to go.

Strongly agree, agree, disagree, strongly disagree.

13 of 32

There are clear instructions on how to use the package.

Strongly agree, agree, disagree, strongly disagree.

14 of 32

There are consistent procedures throughout the package.

Strongly agree, agree, disagree, strongly disagree.

15 of 32

The videos are worthwhile and supported my learning.

Strongly agree, agree, disagree, strongly disagree.

16 of 32

The information on screen is easy to read.

Strongly agree, agree, disagree, strongly disagree.

17 of 32

The presentation is informative.

Strongly agree, agree, disagree, strongly disagree.

18 of 32

The package is enjoyable to use.

Strongly agree, agree, disagree, strongly disagree

19 of 32

The package provides useful word support and glossaries for the topic.

Strongly agree, agree, disagree, strongly disagree

20 of 32

The package provides good advice on how to work through the material.

Strongly agree, agree, disagree, strongly disagree

21 of 32

It helps you learn about the topic.

Strongly agree, agree, disagree, strongly disagree

22 of 32

It fits well with the rest of my course materials.

Strongly agree, agree, disagree, strongly disagree

23 of 32

The time spent using the Movement Analysis package is well worth it.

Strongly agree, agree, disagree, strongly disagree

24 of 32

It would help me to revise the subject.

Strongly agree, agree, disagree, strongly disagree

25 of 32

I would use it again in my own time.

Strongly agree, agree, disagree, strongly disagree

The Movement Analysis package is designed to help you improve your knowledge of anatomy. Please use the following questions to comment on how you think the Movement Analysis package has improved (if at all) your knowledge and skills.

26 of 32

Your general knowledge of anatomy

27 of 32

Your understanding of anatomy.

28 of 32

The way in which you might apply what you have learned in the future.

29 of 32

Did you like using the Movement Analysis package to support your learning of Anatomy?

Yes / No

Please provide up to 3 reasons as to whether you liked or disliked using the package.

30 of 32

Rank in order which of the following methods you would prefer to use when learning about movement in anatomy. (Start with 1st being the method you would most like.)

On-line via a web browser

By using a CD and inserting it into your own computer.

Through paper based self study.

Face to face in lectures and/or tutorials

Practical class

31 of 32

Are there any improvement you could suggest that should be made to the learning material?

Yes / No

If yes to the above, what improvements do you suggest?

32 of 32

Please add any other comments you would like to make about the Movement Analysis Package.

Appendix 8

Manual Therapy / Stroke Package Evaluation Questionnaire

(This document is a copy of the questions from the on-line version of the form and as such does not contain the response boxes, for the original version of the form please go to the web site in the methods chapter.)

Evaluation of the manual therapy / stroke package is an important quality assurance tool which will ensure that the package meets your requirements. To this end, we would be grateful for your assistance in completing the evaluation form. Thank you.

1 of 32

Please select your course from the drop down list:

BSc Hons Physiotherapy

MSc (pre-registration) Physiotherapy

BSc Hons Occupational Therapy

BSc Hons Sports and Exercise Science

If other please clarify:

2 of 32

Select your current year:

1st

2nd

3rd

4th

Other

3of 32

What is your gender?

Male

Female

4 of 32

Which age group are you?

27 or under

28 or over

The following questions relate to your general feelings about using computers. Please rate how much you agree/disgaree with each statement.

5 of 32

Given a little time anybody could learn to use a computer.

Strongly agree, agree, disagree, strongly disagree.

6 of 32

I find a computer difficult to use.

Strongly agree, agree, disagree, strongly disagree.

7 of 32

Computers isolate you from other people.

Strongly agree, agree, disagree, strongly disagree.

8 of 32

I think computer literacy will make me more employable.

Strongly agree, agree, disagree, strongly disagree.

9 of 32

I am afraid of looking silly of I make a mistake while using the computer.

Strongly agree, agree, disagree, strongly disagree.

10 of 32

Please indicate by selecting the relevant option, how confident you feel about the following:

Very confident, Confident, Some confidence, Little confidence, No confidence.

Using web browsers such as internet explorer

Navigating materials on-line

Reading materials on-line

Using multimedia e.g. video clips

Working independently at a computer

Using computers for self-study

The following questions relate to your use of the Manual Therapy / Stroke Package.

Please rate how much you agree/disagree with each statement.

11 of 32

It is clear what options are open to you at each stage.

Strongly agree, agree, disagree, strongly disagree.

12 of 32

It is easy to navigate where you want to go.

Strongly agree, agree, disagree, strongly disagree.

13 of 32

There are clear instructions on how to use the package.

Strongly agree, agree, disagree, strongly disagree.

14 of 32

There are consistent procedures throughout the package.

Strongly agree, agree, disagree, strongly disagree.

15 of 32

The videos are worthwhile and supported my learning.

Strongly agree, agree, disagree, strongly disagree.

16 of 32

The information on screen is easy to read.

Strongly agree, agree, disagree, strongly disagree.

17 of 32

The presentation is informative.

Strongly agree, agree, disagree, strongly disagree.

18 of 32

The package is enjoyable to use.

Strongly agree, agree, disagree, strongly disagree

19 of 32

It helps you learn about the topic.

Strongly agree, agree, disagree, strongly disagree

20 of 32

It fits well with the rest of my course materials.

Strongly agree, agree, disagree, strongly disagree

21 of 32

The time spent using the Movement Analysis package is well worth it.

Strongly agree, agree, disagree, strongly disagree

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It would help me to revise the subject.

Strongly agree, agree, disagree, strongly disagree

23 of 32

I would use it again in my own time.

Strongly agree, agree, disagree, strongly disagree

24 of 32

I feel more confident towards computer assisted study materials.

Strongly agree, agree, disagree, strongly disagree

25 of 32

It has allowed me access to a useful resource.

Strongly agree, agree, disagree, strongly disagree

Please use the following questions to comment on how you think the Manual Therapy / Stroke package has improved (if at all) your knowledge and skills relating to Manual Therapy / Stroke.

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Your general knowledge of Manual Therapy / Stroke

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Your understanding of Manual Therapy / Stroke

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The way in which you might apply what you have learned in the future.

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Did you like using the Manual Therapy / Stroke package to support your learning of Anatomy?

Yes / No

Please provide up to 3 reasons as to whether you liked or disliked using the package.

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Rank in order which of the following methods you would prefer to use when learning about Manual Therapy / Stroke. (Start with 1st being the method you would most like.)

On-line via a web browser

By using a CD and inserting it into your own computer.

Through paper based self study.

Face to face in lectures and/or tutorials

Practical class

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Are there any improvement you could suggest that should be made to the learning material?

Yes / No

If yes to the above, what improvements do you suggest?

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Please add any other comments you would like to make about the Manual Therapy / Stroke Package.