Combining a Data Management System and Case-Based Learning to Address Various Types of Needs in Equine Orthopaedics

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Compte rendu d'expérience

Abstract

This article describes a clinical data collecting system in the field of equine orthopedics, which was implemented and experimented to optimize the use of the entire caseload of The Philip Leverhulme Equine Hospital by generating automatically online learning activities.

A Microsoft Access database was designed to collect clinical data and documentation about patients. The scripting language of a website interacts with the database to allow retrieval of data for case presentation, viewing of medical techniques and practice of clinical observations and diagnoses. Self-assessment with mechanized feedback and analysis of performance allow reflective learning.

Résumé

Cet article décrit un système de collection des données cliniques dans le domaine de l'orthopédie équine qui a été testé au Philip Leverhulme Equine Hospital. Ce système génère automatiquement, au départ de tous les patients examinés, des activités d'apprentissage en ligne.

Une base de données Microsoft Access est utilisée pour recueillir les informations cliniques et l'ensemble de la documentation pour chaque cas. Le langage informatique d'un site Web interagit avec la base de données pour permettre le retrait d'informations et la présentation de cas, la pratique d'observations et diagnostics cliniques ainsi qu'une autoévaluation, un *feedback* automatisé et une analyse de sa propre performance par chaque étudiant.

1. Introduction

In the United Kingdom, recommendations from the Royal College of Veterinary Surgeons (RCVS) underpin the teaching strategy of the "Day one skills", which are the attributes expected for veterinarians at graduation, and the "Year one skills", which are the competences to be acquired in the first year of professional life. The graduate attributes include also general skills called Key (transferable) Skills, and ethical or professional values (Royal College of Veterinary Surgeons Education Strategy Steering Group, 2001).

In the veterinary profession, as in human medicine, there is increased pressure to demonstrate the basis of the clinical approach and adopt quickly the results of science into practice. The Veterinary Surgeon has an ethical obligation to provide effective and safe treatments. Continuing education has become compulsory. In the future, veterinarians should also be able to demonstrate they can adopt an Evidence Based Medicine (EBM) approach (Cockcroft & Holmes, 2003a, Introduction). This leaves practitioners with a considerable task and pressure (Collins, 2003).

"Quality" has become all pervasive in modern society and has been adopted by higher education (Brennan, 1997; Leclercq, 1998; Romainville & Boxus, 1998; Sebkova, 2001). Education is now countering the dominance of research in the traditional academic triumvirate of teaching, research and service, increasing therefore the pressure on the academic clinician.

The objective of the Equine Studies department of the University of Liverpool was to implement and experiment a data collecting system in the field of equine orthopedics that would optimize recording of clinical data and documentation of the cases by generating automatic applications in veterinary practice, research and teaching. Data retrieval and clinical research would be improved. The entire caseload would be available to all students through Case-Based e-Learning activities. This technology would also help develop accurate data recording, systematic clinical approach and appraisal of performance, which are essential aspects of Evidence-Based Medicine.

2. Material and Methods

2.1 Assessment of Needs

2.1.1 The Institution's Needs: Improving Case-Based Learning

Clinical Studies at the Faculty of Veterinary Science of The University of Liverpool are concentrated in the last part of the Third Year, Fourth and Fifth Years of study. Formal teaching is provided in the *Clinical Theory Course*, which includes lectures. The next part of the course is spent on C*linical Rotations,* which provide an opportunity to gain experience in practical aspects of medicine and surgery under close supervision.

Teaching on clinics is centered on work with patients. However it is not possible to guarantee availability of clinical material at any time, nor is it possible to guarantee that all students will see the same range of diseases.

In equine orthopedics, 1000 cases present each year at the hospital. As students spend only two weeks in this subject, they will not benefit from the whole caseload.

According to Poumay (2001), there are different reasons to promote learning and teaching with cases. Case-Based Learning Methods (CBLMs) favor reasoning, provide nutriments to the learner's conceptual network, promote schemata constructions, are sources for vicarious experience, allow personal involvement via emotion, reassure learners, make them feel confident, help transfer to practice and develop higher order skills. This author shows also how Case Based Learning Methods help vary learning paradigms.

The "time on task principle" (Berliner, 1984; Chickering & Gamson, 1987) and Kolb's Learning Cycle theory (Kolb, 1984) recalls that repeating learning experiences is essential. Poumay (2001) stresses that real cases are better for CBLMs.

A technology should be designed to optimize the use of the large clinical caseload of the Hospital and make all the cases available to all students for e-learning activities. The possibility of inclusion of other real cases from private practice is also considered.

2.1.2 Students' Needs: Improving Clinical Approach and Self-Efficacy

Veterinary surgeons collect and process data to form a diagnosis. Systematic approach and recognition of abnormality and normality are important aspects of equine orthopedics. Students must learn data acquisition, clinical reasoning and dealing with uncertainties (Cockcroft & Holmes, 2003a, Diagnosis).

An interview of thirty veterinary students of the University of Liverpool and the University of Liège was carried out and revealed that self-efficacy is a major concern. Self-efficacy is one's confidence in one's ability to perform a task for a determined objective (Bandura, 1980). Students want to see more practice and want to see the link between teaching and real life.

Clinical work can develop understanding and skills to a certain extent but the limited time spent on clinics has immediate implications on self-efficacy and development of clinical approach, which may be improved by repetition of clinical observation online on real cases, with self-assessment and feedback.

2.3 The Profession's Needs: Development of Evidence Based Veterinary Medicine (EBVM)

EBM (Evidence Based Medicine) refers to "the conscientious, explicit and judicious use of current best evidence in making decisions about the care of individual patients. The practice of EBM means integrating individual clinical expertise with the best available external clinical evidence from systematic research" (Sackett, Strauss, Richardson, Rosenberg & Haynes, 2000). This approach of teaching and practice medicine has now been introduced in veterinary science. Veterinarians should be able to properly collect clinical data, use a systematic approach, ask and translate the clinical question into a usable search strategy, critically appraise the information, and evaluate their efficiency (Cockcroft & Holmes, 2003a, Introduction). This means that understanding of experimental design, accurate and systematic data-recording, diagnostic approach and appraisal of performance should be taught to undergraduates. Meta-cognition, which refers to "assessments, analyses and regulations made by the learner on his own performances before, during and after a learning activity" (Leclercq & Poumay, 2005), is therefore essential in the teaching strategy.

Other factors make systematic and accurate data recording essential in the veterinary profession.

EBM puts emphasis on randomized controlled trials (Ramey & Rollin, 2001) which, to be valuable, involve large number of patients with concomitant complex study design and advanced statistical calculations (Bladon & Main, 2003). That methodology is singularly lacking in equine medicine. The clinician must recognize that the best evidence may come from case-control studies or carefully documented case series (Marr, 2003). The difficulty of interpreting in vitro studies and ethical concerns over the use of the horse as an experimental model will also limit research (Clegg, 2006). Achieving effective clinical research necessitates access to clinical cases in the field (Mair & Cohen, 2003). Practitioner-based studies have been successfully performed (Cohen, 2003) and should be encouraged. However careful documentation requires systematic and organized recording of data (Cockcroft & Holmes, 2003a).

Audits will probably be implemented in the future and will assess whether good practice is being applied (Mosedale, 1998). Treatments and outcomes will be found in practice records and will be compared with those available from the best evidence according to the published literature. Reliable and reproducible recording of observations will be essential.

3. Design Of The Database and Website

In equine orthopedics, very few systems to collect clinical data exist and no computer database has yet been described. The use of an orthopedic record sheet *(« la grille orthopédique »)* has been reported (Desbrosse, 1990). This system is made of handwritten sheets and has therefore limitations to use the considerable data collected over years.

In this project, a database was developed in Microsoft Access that uses a relational model, as a set of connected tables. The main feature of the DB is the use of primary and foreign keys to link tables with 'one to many' and 'many to many' relationships (Date, 1990). The task resulted in a design of approximately 30 tables. They include the animals' details and history, about 500 clinical observations, the diagnoses and treatments. References to documentation such as digital photos, videos, radiographs, ultrasonographic and scintigraphic scans constitute another 1000 parameters. Clinical observations that are found interesting and that might generate questions for students can be selected by the inactivation of a parameter called "display to student" in the database (Figure 1, Annex 1). Each case is classified with reference to possible learning activities. The learning activities refer to the competences expected at graduation for lameness and orthopedic conditions investigation as detection and description of abnormalities on passive, dynamic and imaging examination, and reflection on differential diagnosis, treatment and prognosis of diseases (Figure 2, Annex 1).

The clinical data are recorded in real time on clinics with students. This means that data recording is carried out as usual without any extra-time required.

The database is then published on the website of the Teaching Hospital. A set of active web pages allow information retrieval from the database using SQL (Structured Query Language). Students can use the website for case presentations or viewing techniques. Students can select the learning activities they find appropriate (Figure 3, Annex 1). The Visual Basic Scripting language used on the website interacts with the database to identify the cases relevant for the learning activity that has been chosen and generate automatically a question relating to the observation that was selected with the "display to student" function, and mask the result for that observation recorded by the clinician ("the expert's answer"). The answers must be submitted with a percent of confidence (Leclercq, 1983; Leclercq & Bruno, 1993; Leclercq & Poumay, 2005) and are stored in the database (Figure 4, Annex 1). All clinical pieces of information (general exam, back palpation, limb examination…), pictures, videos, radiographs and scans can be displayed to support or illustrate the questions (Figure 5, Annex 1). When students work on the website and submit their answer, it is automatically compared to the data recorded on clinics by the clinician (the expert's answer) and followed by a mechanized feedback (Figure 6, Annex 1). Their grades and confidence per learning activity can be displayed in a graph to analyze alone their performance, regulate their learning and guide their choice in learning activities (Figures 7 and 8, Annex 1).

4. Experimentation and Results

4.1 Practicability of the System in the Institution and the Veterinary Profession

As the use of computer databases may appear time consuming and might discourage veterinarians from using them (Cockcroft & Holmes, 2003b) and building cases for CBLMs is time consuming (Poumay, 2001), experimentation was required to demonstrate the practicability of the system and its ability to optimize the time spent on clinics.

Fifty orthopedic cases were randomly chosen at the Equine Hospital. Clinical data were recorded in three different ways: in the database, on hand-written data sheets and in the orthopedic flow-chart *(la grille orthopédique)* described by Desbrosse (1990). Three students and three clinicians took part in the study, and were randomly allocated a data collecting technique for each case. The time spent to record clinical data, to dictate and typewrite the reports, to retrieve information in the records or carry out a statistical analysis, was assessed.

The experimentation showed that the time required to record history is similar on average with the three systems (10 minutes). The time spent to input the results of examination and imaging is similar for the database and handwritten sheets (21 minutes), but is less with the orthopedic flow chart, only slightly when taken by students (18 minutes) and more significantly with experienced clinicians (10 minutes). Dictating and typewriting reports range from 10 to 30 minutes from hand-written record sheets and charts, while it is nearly instantaneous with the "edit report" function of the database. With the database and flow-chart, much more data are recorded. This has immediate consequences on the time for retrieving data. The information can be found in less than 1 minute with the database or chart, while it may take more than 20 minutes or simply not be found at all with the hand-written records. The simulations of statistical analyses have shown that it can be performed in a few minutes with the database while it is nearly impossible with the other systems (the experimentation was stopped after 120 minutes).

4.2 Adequacy to Students' Needs

A survey was carried out on sixty 4th year students (50% of the fourth year population) during clinical rotation. The first part of a questionnaire referred to their expectations from e-learning in equine orthopedics and how self-assessment and feedback should be implemented. The results corroborated with the assessment of needs reported above. Students express their interest for access to a wide range of genuine clinical cases, including common conditions seen in practice, covering subjects that might be missed on clinical rotations, with documentation as slow motion videos, pictures and radiographs, including comparisons between normal and abnormal findings. Students think e-learning would allow them to work at their own pace, focusing on areas of interest or weakness. Self-assessment should be ideally carried out as MCQ's. Answers or reasoning afterwards should be given as feedback, with scores or grades.

Immediately after the questionnaire, E-Quine Ortho was presented to students who were asked to assess on a scale from zero (no interest, bad) to four (high interest, very good) the adequacy of the tool to their expectation, the learning activities suggested, the system of short answers, the mechanized feedback and the graphic representation of their performance.

A mean score of 3.5 was given for the adequacy to their general expectations and the learning activities available. The short answer system and the graphic representation of their performance were graded 3. Students gave a score of 2.7 for the mechanized feedback, which might reflect some interest for more extended feedback on their answers.

5. Applications and Further Developments

This technology enables the recording of clinical data, pictures, radiographs, ultrasonographs, scans and reports. The appropriate design of a collecting data system optimizes the time spent on clinics by automatically generating useful applications in education, veterinary practice and research. The database was tested on clinics each week all along its design. Changes were implemented following comments from clinicians and students. Using a database to support cases, documentation and learning activities simplifies further regulation. Owing to the relational model, any change in a table can be implemented without interfering with the main structure of the software.

All the cases and documentation is available online to all students. They can repeat clinical approach and observations as often as they want, and at their own pace. Self-assessment, feedback and regulation are possible. This should improve reflective learning. The emphasis has been placed on assessments and feedback to support learning (Gibbs, 2003). Mechanized feedback, trade off of quality of feedback against speed of return and development of student self-supervision (meta-cognitive awareness and skill) are essential (Gibbs & Simpson, 2003; Leclercq & Poumay, 2004). A research project was carried out in 2006 to assess the effect of e-Quine Ortho on students' performance and self-cognition (Vandeweerd, Davies, Pinchbeck & Cotton, In press).

The tool can be used for data retrieval online and can improve communications between clinicians and referring veterinary surgeons. This data collecting system can obviously improve clinical research.

The authors have also considered the feasibility of extending the database as a resource for practices to share expertise and make genuine cases from practice available to students. In order to achieve this, technical details need to be in place. A single database would be required with user access over the Internet. On the management side there are quality control and administrative issues. Clearly there would be a need for editorial control. Definitely, the technology might help input of data and experience from practice in research and teaching. However, this aspect needs further development, experimentation and participation of the professional associations.

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Annex 1

Figure 1. Clinical data including detection and description of abnormalities for passive examination, dynamic examination and imaging, and reflection on diagnosis or treatment, are recorded in a Microsoft Access Database. The "display to student function" can be activated or not.

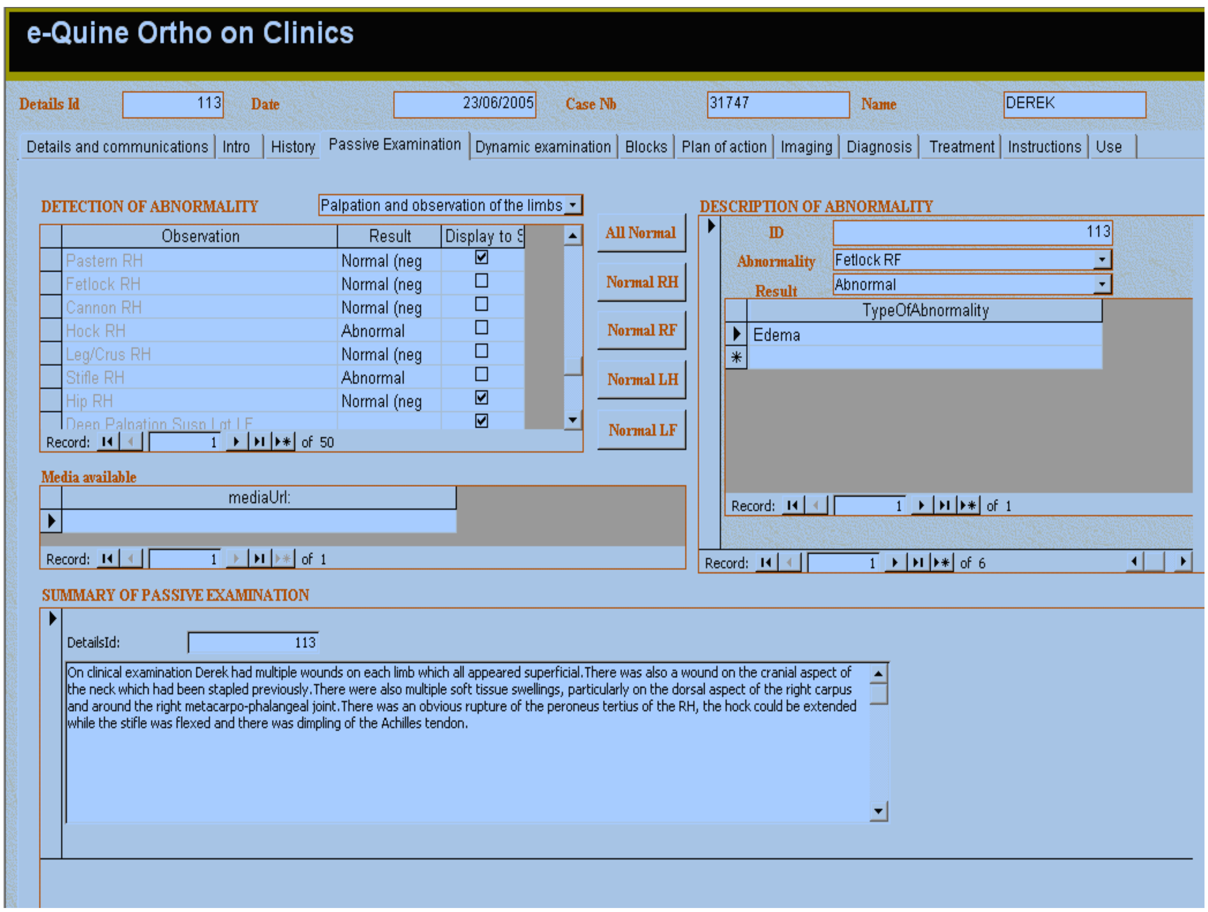

Figure 2. The possible learning activities (left part of the screen) from the case are selected at the end of examination.

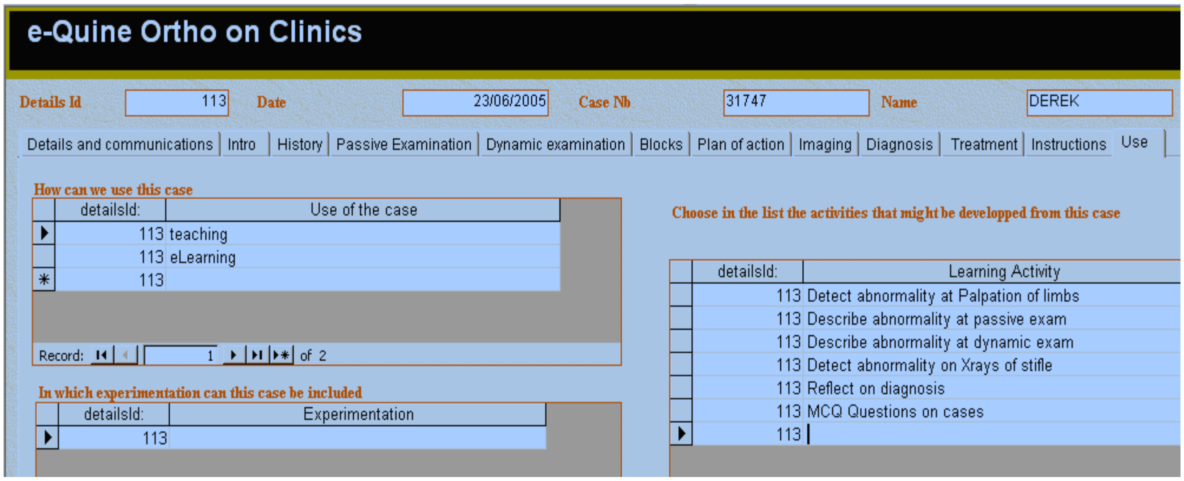

Figure 3. Students can choose a learning activity on the website (detection of abnormalities, description of abnormalities at passive, dynamic and imaging investigation. Reflection on diagnosis, treatment or prognosis, MCQs on the case).

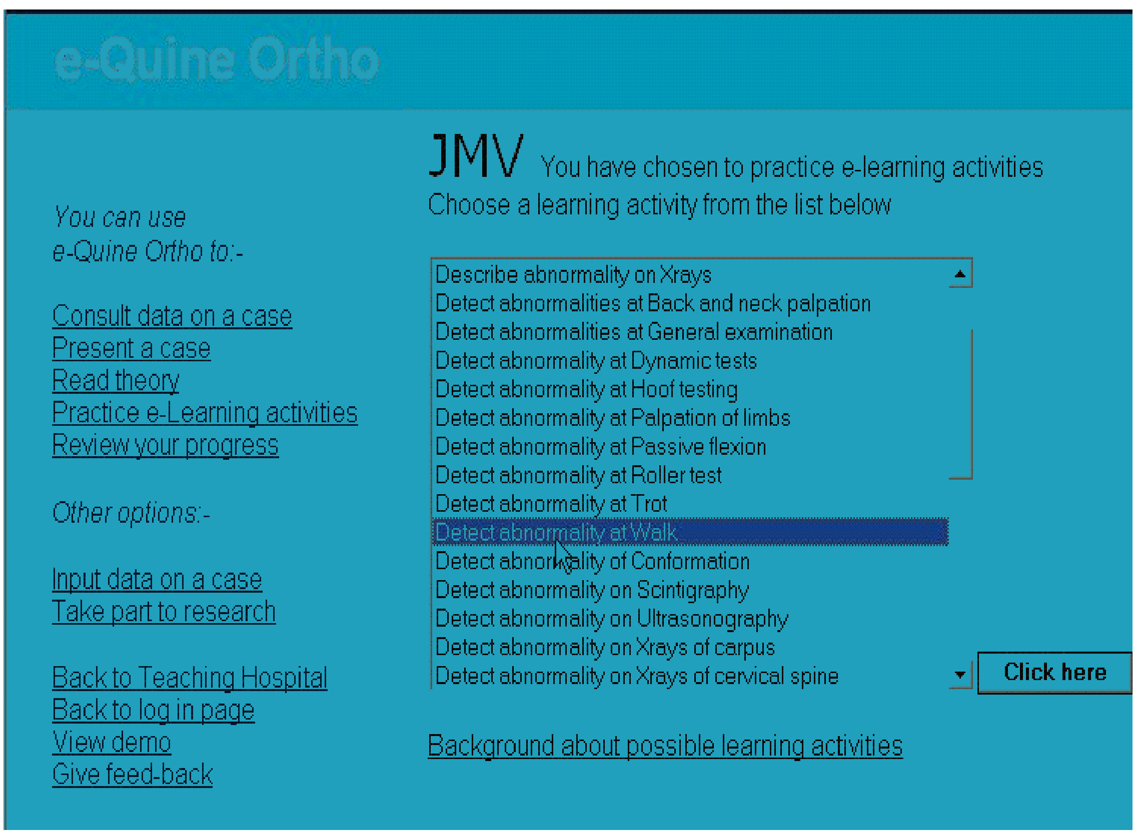

Figure 4. Answers are submitted with a percent of confidence.

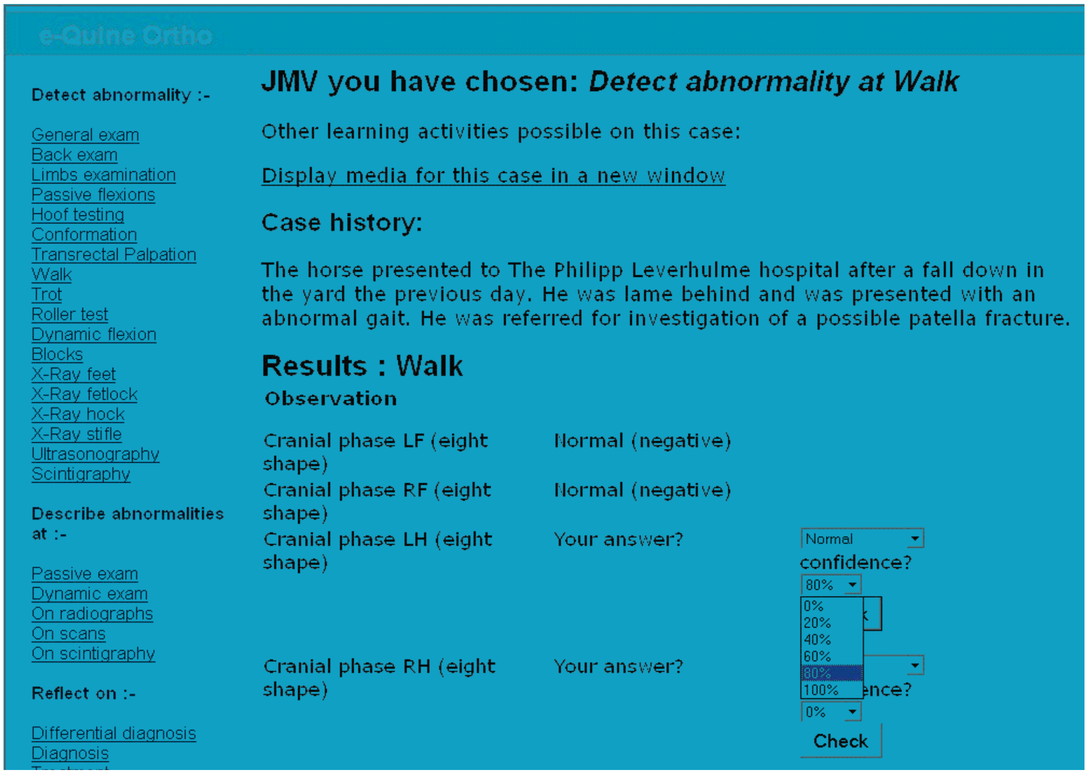

Figure 5. All the media about the case (pictures, videos, x-rays, scans) can be displayed.

Figure 6. Automatic feedback is given.

Figure 7. Users can also review their progress (general or in a specific learning activity).

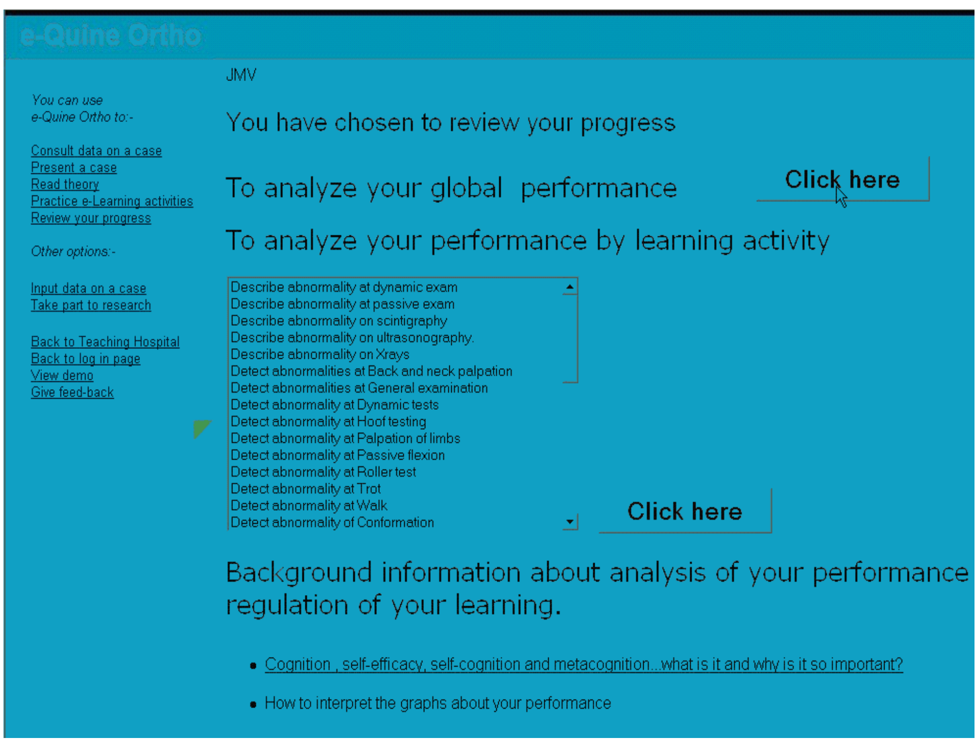

Figure 8. The spectrum of their results can be displayed. Correct answers are positive and negative answers are negative. The figure corresponds to the percent of confidence (20, 40, 60, 80 and 100%).