編號：CCMP98-RD-018

# 望診教學與動態評量系統

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## 摘　要

**研究目的：**

近年來中醫在西方醫學界中引發一波新潮流，如 1997 年美國統計超過百分之四十之民眾接受過 Complementary and Alternative Medicine (CAM)，而每年支出更高達兩百億美元、世界衛生組織(WHO)亦估計全球 CAM 每年產值達六百億美元且已有高達三分之二健康保險機構(HMO)表示願意負擔某些另類醫療支出等，因而使得中醫診治一致性越來越受到醫學界熱切關注，且許多論文均開始探討中醫診斷一致性之問題，推導得針對特定疾病醫師間一致性並不高之結論，凸顯了針對一致性進行再教育之重要性。中醫四診合參並以望診為首，中醫望診之教學，多仍依循傳統教法，學習之地點、時間及型態受限。本計畫旨在運用電腦技術，提供中醫望診之教學者及學習者一數位化多元學習資源及評量平台。

**研究方法：**

學習與評量系統以人眼視覺、望診教學、動態評量三大面向呈現望診內容，除補充既有之舌頭影像外，亦納入面診、望皮膚及望指甲三項，運用電腦以動態評量方式輔助教學，協助提供中醫望診教學及評量之進行。

人眼視覺：人眼視覺系統區分為眼睛結構、視覺原理與生理機制，另包含色彩系統與色彩管理。

舌診理論：舌診教學內容區分為舌診起源、歷史發展與舌診研究內容三個層面加以說明，包含概要、發展源流、傳統文獻、著名醫家、舌診內容、自動分析與相關內容。

面診理論：面診教學內容主要簡介面診起源、歷史發展與面診相關理論，包含概要、發展源流、傳統文獻、著名醫家、面診內容與相關內容。

望指甲理論：望指甲教學內容主要簡介望指甲起源、歷史發展與望指甲相關理論，包含概要、發展源流、傳統文獻、著名醫家、望指甲內容與相關內容。

望皮膚理論：望皮膚教學內容主要簡介望指甲起源、歷史發展與望指甲相關理論，包含概要、發展源流、傳統文獻、著名醫家、望皮膚內容與相關內容。

教學評量：望診之教學及評量是以 PHP 來完成應用程式伺服器之建立，以 MySQL

作為系統之後端資料庫,以 PHP 等程式語言技術來完成整個系統之程式撰寫工作。

## 結果與討論：

建置中醫望診學習與評量系統，提供傳統望診理論、範例影像、專家判讀結果，佐以近代相關學術論文、書籍及專利，提昇中醫師望診教育廣度及深度，將有助於望診循標準化之客觀判別程序，獲得可靠斷症結果，提高中醫臨床應用價值;運用電腦以動態評量方式輔助教學,取代過去傳統教學弊病,實現遠距教學，在教導與學習能事半功倍。本計畫成果經整理已投稿至 5th International Congress on Complementary Medicine Research in Tromsø , Norway May 19-21, 2010 (ICCMR 2010)(參見附件 1)。

關鍵詞：人眼視覺、望診教學、動態評量

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# Digital Learning and Dynamic Evaluation System for Traditional Chinese Diagnosis through Observation

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## ABSTRACT

### Aim:

Clinical practice is indispensible in both the theory and application of Chinese Medicine. Traditional Chinese Medicine study relied mostly on accumulation of experiences. Related information is collected from a large number of cases and clinical observations for subsequent analysis, induction, and application. Along with popularization of academic theses, books, and publications in recent years as well as dynamic evaluations as the learning proceeds to fulfill intellectual decision-making and reach better learning effects, The proposed Digital Learning and Dynamic Evaluation system for traditional Chinese Diagnosis through Observation (DLDEDO) is adapted to the diverse aptitudes of different students with accurate differentiation and more adaptive learning assistance.

### Method:

The DLDEDO contains a multi-tier distributed database server connected to the World Wide Web. System maintenance and update can all be done at a remote terminal via the network, saving time and promoting efficiency.

Contents of the DLDEDO cover three major aspects, human vision, teaching of inspection diagnosis, and dynamic assessments. In human vision, structures of the eye, principle of vision and physical mechanism, including the color system and color management, are briefly introduced. The materials in inspection diagnosis can be classified into four theories (the tongue diagnosis, face diagnosis, inspection of fingernails and inspection of the skin) and four types (notable humans, things, events, and references). Information on doctors, history and development, research content, and related literature is gathered and refined. The teaching evaluation system is developed, with the help of computer network and digital image technology, to fit the diverse aptitudes of different students. It is based on the traditional inspection diagnosis theory, and contains inspection diagnostic images already interpreted by experts and incorporates dynamic assessment methodology.

## Results & Discussion:

The inspection diagnosis teaching and evaluation system provides diversified learning channels, collects study information on tongue diagnosis, face diagnosis, fingernail inspection, and skin inspection, and offers exemplary images that have been interpreted by experts, assisted with contemporary related academic theses, books, and patents, enhancing the extensiveness and depth of inspection diagnosis education for Chinese Medicine practitioners. The computeorized teaching system is not limited by time or space. Information is accessible thrugh Internet and users can conduct self evaluation. The dynamic evaluation, featuring “teaching students according to their individual aptitudes,” can provide adequate learning assistance. It is a cultivation system for modern Chinese Medicine.

Keywords: Human vision, teaching of inspection diagnosis, Dynamic assessment

# 壹、前言

近年來中醫在西方醫學界中引發一波新潮流，如 1997 年美國統計超過百分之四十之民眾接受過 Complementary and Alternative Medicine (CAM)，而每年支出更高達兩百億美元、世界衛生組織(WHO)亦估計全球 CAM 每年產值達六百億美元且已有高達三分之二健康保險機構(HMO)表示願意負擔某些另類醫療支出等，因而使得中醫診治一致性越來越受到醫學界熱切關注，且許多論文均開始探討中醫診斷一致性之問題，推導得針對特定疾病醫師間一致性並不高之結論，凸顯了針對一致性進行再教育之重要性。

中醫四診合參並以望診為首，透過觀察病人進而擷取疾病相關訊息，其研究之基礎或應用均須臨床實踐，傳統中醫研究多仰賴經驗累積，於大量原始病例與臨床觀察過程中記錄相關訊息，進行分析、歸納與應用，再將記錄結果套用至臨床診療，為一非常漫長之過程，將此過程進行簡化和快速分析，透過電腦提高其效率，是發展中醫現代化相當重要之關鍵；傳統中醫藥從業人員之養成多屬師徒傳承制，透過板書、教具講授與臨床診療而獲取相關知識，隨著通訊科技之進步，透過電腦計算與網路技術，提出一學習與評量系統，針對專家分析之望診影像作解讀、判斷、相關知識學習與自我評量，佐以近代相關學術論文、書籍及發明，並視學習進程提供動態評量以達智慧型決策與輔助之應用價值，不受時間限制且具有一致性輸出，「因材施教」之人性化評量方式具備準確區辨力與助益力，提供更適切學習幫助；中醫望診學習系統協助醫生診斷病症並滿足中醫現代化養成教育體系之需求，動態評量亦提供未來使用者多元化學習資源及學習管道。本計畫成果經整理已投稿至 5th International Congress on Complementary Medicine Research in Tromsø , Norway May 19-21, 2010 (參見附件 1)。

## 貳、材料與方法

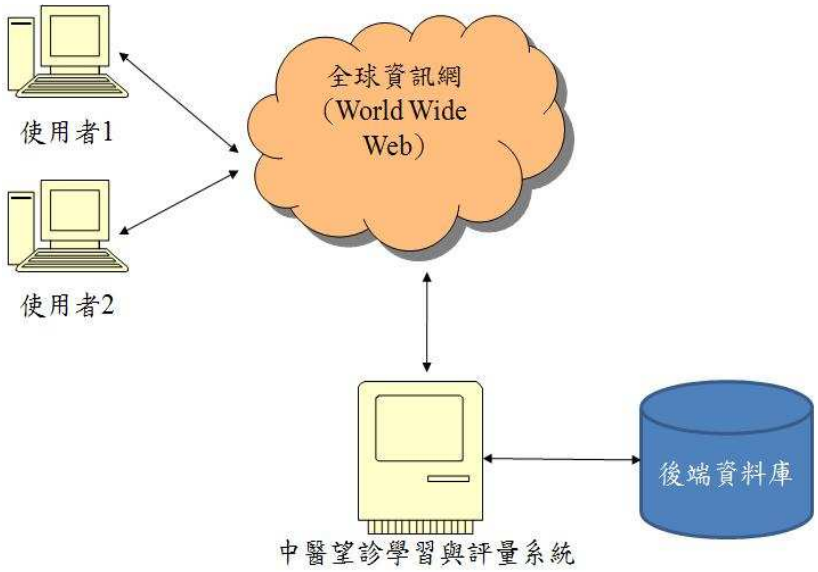


圖 1. 系統架構

中醫望診學習與評量系統建構於全球資訊網上，連結後端資料庫，設計架構採多層式(Multi-Tier)分散資料庫架構（參見**圖** 1），相關維護與更新，均可透過遠端伺服器操作，節省時間並增進效率。

網路教學是指將教學進程與學習活動自傳統課堂轉換至網路上，以網路為媒介，將課程內容傳達予遠方學習者，並應用資訊科技協助學生學習之教學方式，其中系統介面設計對於學習者學習經驗與成效影響極大，中醫望診學習與評量系統介面可區分為使用者與教學者兩部分，使用者介面代表系統與使用者溝通管道，包含傳遞系統功能之物件與元素，教學介面代表協助學習者進行學習活動之元素，一個設計良好之介面能令學習者專注於學習內容，而非如何操作系統；網路教學系統設計準則多源自人機互動領域中之設計準則，其中兩大重要類別為流程設計及評估與符合使用者經驗，而教學介面設計準則中最重要前五點計有使用效能（內容，格式，互動，導覽方式）比外觀重要、清楚按鈕及使用說明、操作簡單容易、支援瀏覽器之連結速度與下載時間、加強使用者之間溝通功能。

學習與評量系統以人眼視覺、望診教學、動態評量三大面向呈現望診內容；人眼視覺簡介人眼結構、視覺感知原理與生理機制，包含色彩系統及色彩管理；望診教學計有舌診、面診、望指甲、望皮膚四項理論，分人、事、物、參考資料四大種類，收集醫家、歷史起源與發展、研究內容及相關文獻；教學評量透過網路及電腦數位影像技術，根據傳統望診理論，佐以專家判讀之望診影像，應用動態評量特性，發展「因材施教」之評量系

統，架構如（參見圖 2）；由系統三大面向出發，以下針對人眼視覺、望診四項理論與教學評量分別概述之：望診透過眼睛觀察病人以擷取疾病相關訊息，人眼於望診扮演重要地位，如何將眼睛所見影像傳達至大腦並做適當判斷以及影響眼睛成像之因素，皆與眼睛成像原理及生理機制息息相關；數位影像由各種顏色所組成，了解影像色彩系統之定義及人眼與色彩系統相關性，以對所見影像有初步認識。

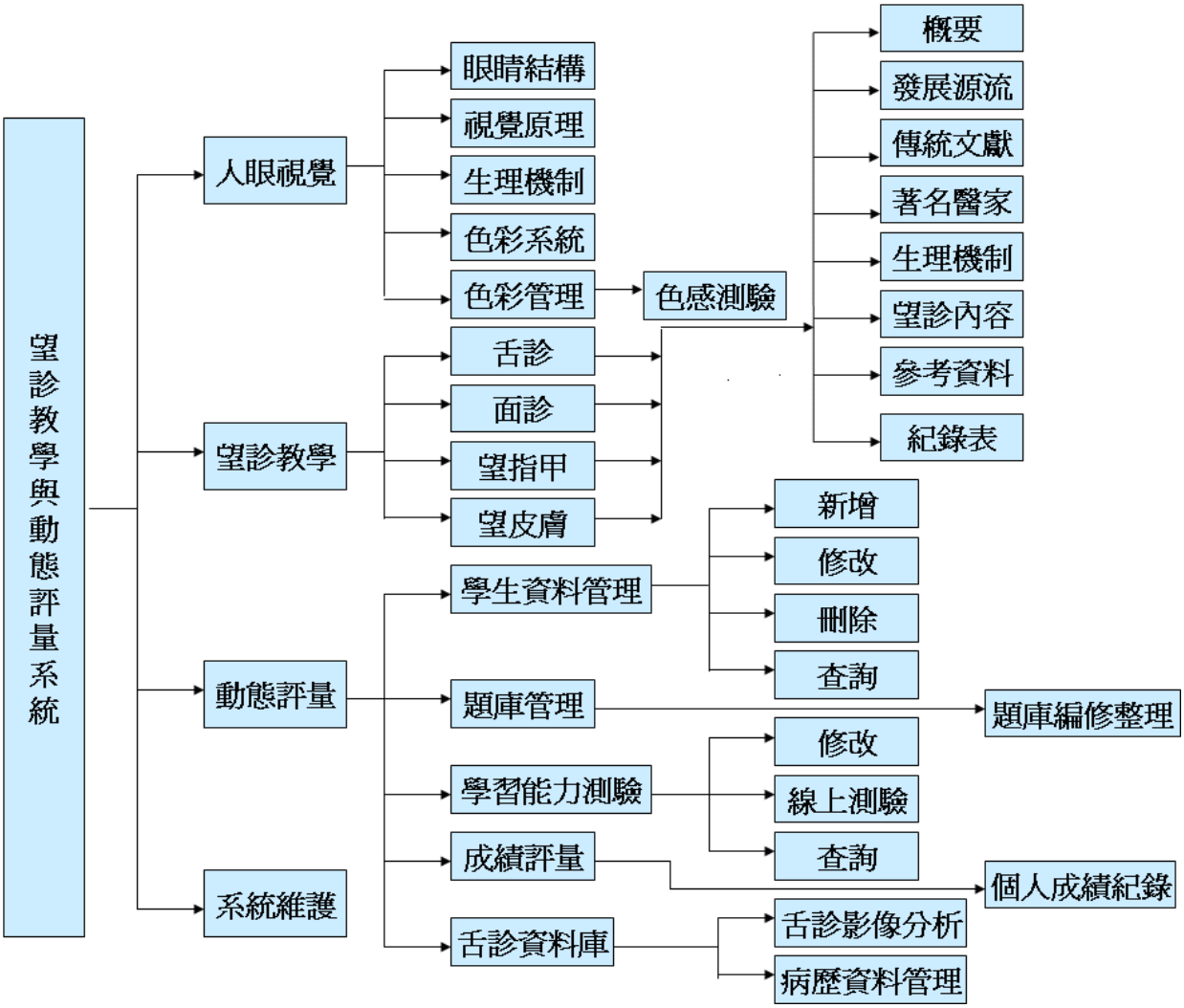


圖 2. 系統架構圖

由人眼視覺系統（參見圖 3）出發，區分為眼睛結構、視覺原理與生理機制，另包含色彩系統與色彩管理；眼睛結構方面主要分為眼球壁與眼內容兩部分，針對人眼組成與內部組織功能加以簡單介紹，並檢附人眼構造圖；視覺原理分視覺形成、眼睛運動、立體視覺三部分，視覺形成概述人眼擷取影像傳送至大腦過程及視覺與攝影間關係，另簡介視網膜中圓錐細胞及桿狀細胞，眼睛運動介紹眼球之五種運動模式：跳躍、跟蹤、匯合、前庭運動、注視，包含六種眼外肌（側直肌、中直肌、上直肌、下直肌、上斜肌、下斜肌）及其功能，立體視覺講解人類視覺感知立體影像及視差

之基本概念；生理機制方面則針對人眼天生存在之特殊條件而導致誤判之情況加以討論，分為視覺敏感、視覺暫留、視覺錯覺三部分，並提供相關範例與說明；色彩系統共有 RGB、YUV、CMYK 三種色彩系統，講述其定義及差異之處，其中包含亮度色度定義與比較；色彩管理講解兩種色彩校正方法：gamma 校正、白平衡原理，gamma 校正為中間色調數值之亮度調整機制，白平衡為相機針對白色之校正標準，使相機與人眼具有一樣調適功能，並提供一有效之個體色覺檢測機制：色感測驗（參見圖 4），另因外在環境所造成之顏色偏差，擷取受測者相關影像同時需加附校正色卡以校正影像色彩，此部分亦提供標準色卡介紹，最後簡介商用色彩管理產品：X-rite ColorMunki、Spyder 3Studio，校正螢幕與輸出裝置之色彩，以提升色彩準度。


圖 3. 人眼視覺

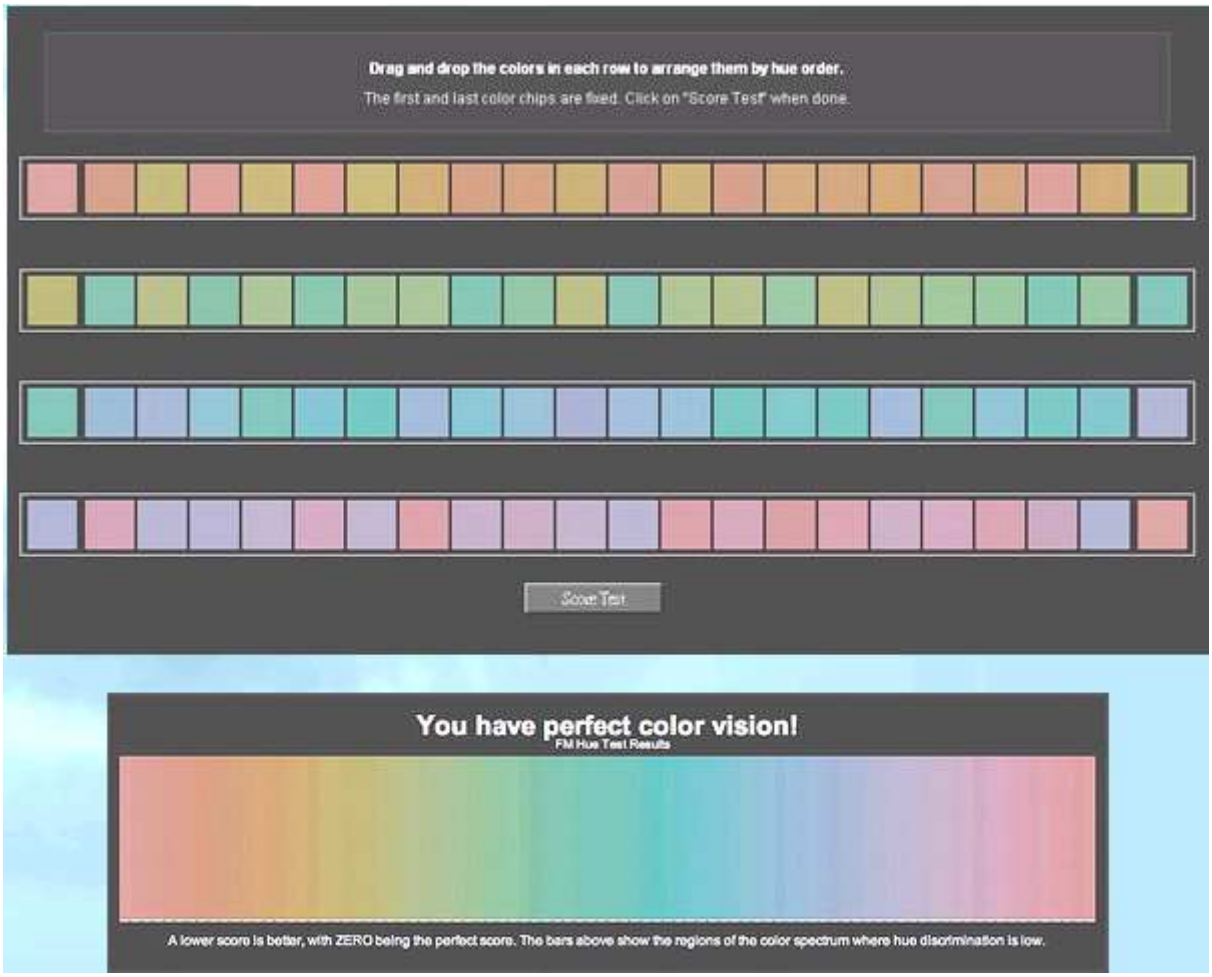


圖 4. 色感測驗

舌頭是人體一面鏡子，與體內臟腑關係密切，體內許多疾病都可透過舌頭反映，觀察舌頭變化狀況，可推知臟腑病變之寒熱虛實與病情之深淺輕重，所以中醫特別重視望舌，稱為舌診。

舌診教學內容區（參見**圖** 5）分為舌診起源、歷史發展與舌診研究內容三個層面加以說明，包含概要、發展源流、傳統文獻、著名醫家、舌診內容、自動分析與相關內容，研究中舌頭影像經中醫臨床診斷所得計有 181 張（參見**圖** 7），每張影像均先經專家判讀，獲得初步結果，再根據舌診電腦化判讀結論進行分析與比對；概要簡述舌診之重要性與臨床意義，並說明中醫舌診學之主要內容，舌頭結構詳細介紹舌頭各部位之專有名詞，如構成舌頭之四條外在肌（頦舌骨肌、舌骨舌肌、莖突舌肌、舌顎肌）與內在肌、舌頭底端包含薄膜狀黏著於口腔底部之舌繫帶、乳突狀突起之味覺細胞：味蕾，臟腑劃分討論舌與臟腑間之密切關係，臟腑之氣可透過經脈聯繫上達於舌，透過經脈循環運行而表現於舌象之變化，舌體從舌尖到舌根分上焦、中焦、下焦，依序介紹各部位舌象變化與心、肺、肝膽、脾胃、腎等器官之關係，檢附舌頭結構與臟腑對應關係圖（參見**圖** 6）；發展源流

概述舌診起源，從古到今計有春秋戰國、漢朝三國、隋晉、唐朝、宋元金、明清、現代，針對各時期詳細介紹，最後簡介「舌」字於各種不同字體之演變；傳統文獻蒐羅脈經等三十二部，透過望診學習系統中「全文檢索」跨文獻搜尋之功能，隨時搜尋資料庫中各部文獻內容，進而於舌診理論中參考各部文獻之內容；並詳細介紹文獻中所提及之著名醫家，依照發展源流之時代分類，計有扁鵲等三十二位，除有醫家基本介紹，另附上對應圖片供做參考。


圖 5. 舌診理論

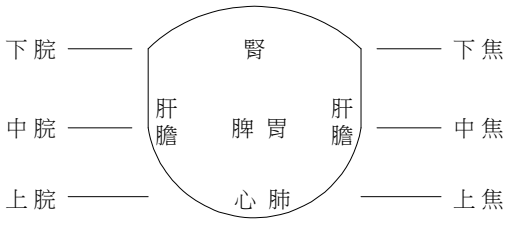


圖 6. 舌頭與人體臟腑對應關係


圖 7. 舌診範例視窗

舌診內容簡介舌頭診斷依據部位，分別詳述與陳列舌苔、舌質與舌體所有可能之表面狀況與相關影像，計有苔色、苔質、舌色、神氣，型態、變化六種分類，苔色分薄白苔、薄白乾苔、厚白膩苔、黃苔、黃膩苔、黃燥苔、薄黃苔、焦黃苔、灰苔、黑苔等十類，苔質分厚薄、潤燥、腐膩、剝落、偏全、真假，舌色分淡紅舌、淡白舌、紅舌、絳舌、青紫舌五種顏色之舌頭，神氣分榮枯與老嫩，型態分舌體大小、強硬度、偏歪舌、顫動舌、伸縮舌五類，變化分正常舌象、裂紋舌、胖大舌、齒痕舌、暗紫舌、淡白少津舌、淡白夾瘀舌、淡白光瑩舌、淡白濕潤舌、鮮紅裂紋舌、鮮紅白點舌、蒼老舌、鮮紅乾燥舌、瘀斑舌、朱點舌、舌下絡脈等十六類，其中舌下絡脈診法為中醫舌診一重要成份，與舌質舌苔一體，主要觀察舌背舌深靜脈之形態變化（暗紫、怒張、結節、水腫），由於舌下脈絡清晰，沒有皮膚覆蓋，故容易由此初步判斷身體患病情況；自動分析介紹現代化舌診電腦系統如何擷取舌頭影像，包含取像環境、分析步驟、前置問卷、判讀表格，最後提供舌診影像上傳與下載，取像環境列出所有影響擷取舌頭影像之因素，包含色溫、光源種類、光源擺設、攝影器材、曝光、外在環境等，舌診影像擷取時需於舌頭兩側置放校正色卡，如此一來即可微調矯正因外在環境所造成之顏色偏差現象，使擷取影像失真降低，分析步驟詳列舌診影像自動化判斷依據，藉此分析步驟循序分析受測者舌頭影像，包含整體分析流程、檢測矩形區域、增加影像對比、影像二值化、邊界檢定、

舌質苔分離、特徵擷取，前置問卷為一統一性表格，為避免外在非必要因素而導致誤判情形，於舌診自動化判讀前紀錄受測者相關資訊，包含檢查日期、室內溫度、飲食溫度、最近飲食時間及飲食（食物、飲料、藥物）內容，以此對受檢者做初步了解，判讀表格記錄舌診影像判讀完畢之結果，同時列出原始影像與辨識影像以供比對；相關內容蒐羅舌診理論所參考之研究資料，包含論文、專利、文獻、網站、中英書籍、歷年中醫師檢定、考題及研究計畫。

顏面望診為幾千年來中醫理論精華一部分，亦是中醫「望、聞、問、切」之一，人體健康受到傷害，面部就會逐步產生症狀，藉由觀察臉部特定位置，分「心、肺、肝、腎、脾、小、大、生」八大部分判斷相對應之器官功能正常與否，稱為面診。

面診教學內容（參見**圖** 8）主要簡介面診起源、歷史發展與面診相關理論，包含概要、發展源流、傳統文獻、著名醫家、面診內容、面診紀錄表與相關內容，所有項目均有「經專家判讀之範例影像，」面診圖像共計 15 張圖像；概要簡述面診重要性及顏面相關部位與體內臟腑之關係（參見**圖** 9、**圖** 10），包含局部特殊徵兆與顏色變化，檢附面診臟腑器官對照圖；發展源流說明面診由西漢至現代演進變化，針對各時期詳細介紹；傳統文獻蒐羅歷代面診著名醫書，於面診理論中參考各部文獻之內容；著名醫家由西漢至明清計有淳于意等十九位，除有醫家基本介紹，另附上對應圖片供作參考。

面診內容包含顏面與周身關係、望面色診病法、望面容診病法三部分；顏面與周身關係分面與臟腑周身及面部望診六部提綱兩大重點，面與臟腑周身詳述局部顏面位置對應人體臟腑與各器官之關係，臟腑肢節於顏面部分布理論可以提示疾病病位，臨證時根據病色出現之具體位置，即能判斷大致病位；面部望診六部提綱描述面部色診中觀察病色出現之內、外、上、下、左、右部位及其動態變化情況，同時參考「望診遵經」內容；望面色診病法分察色知病所在、五色主病、望面知病變輕重淺深、望面知病情並退逆從、察色知疾病預後轉歸五大重點，根據五色命臟原則，不同臟腑病變可出現不同病色，針對面部五類顏色可分別反應不同性質疾病與症候之特性做介紹；望面容診病法分急性熱病面容、慢性消耗性疾病面容、肺癆面容、二尖瓣狹窄面容、皮質醇增多症面容、痙笑面容、假面具面容、肢端肥大症面容、狹腮面容、系統性紅斑狼瘡面容、獅面面容、甲亢面容、黏液性水腫面容、面神經麻痺面容、下頜關節強直面容、貧血面容、脫水面容、傷寒面容、阿狄森氏病面容、肝病面容、垂危面容等二十一大重點，分別簡述不同顏面容貌代表之病症意義與對應治療方式，包含藥方參考；面診紀錄表為一統一性表格，於面診判讀前紀錄受測者相關資訊，判讀表

格記錄面診影像判讀完畢之結果；相關內容蒐羅面診理論所參考之研究資料，包含論文、專利、文獻、網站、中英書籍、歷年中醫師檢定、考題及研究計畫。


圖 8. 面診理論

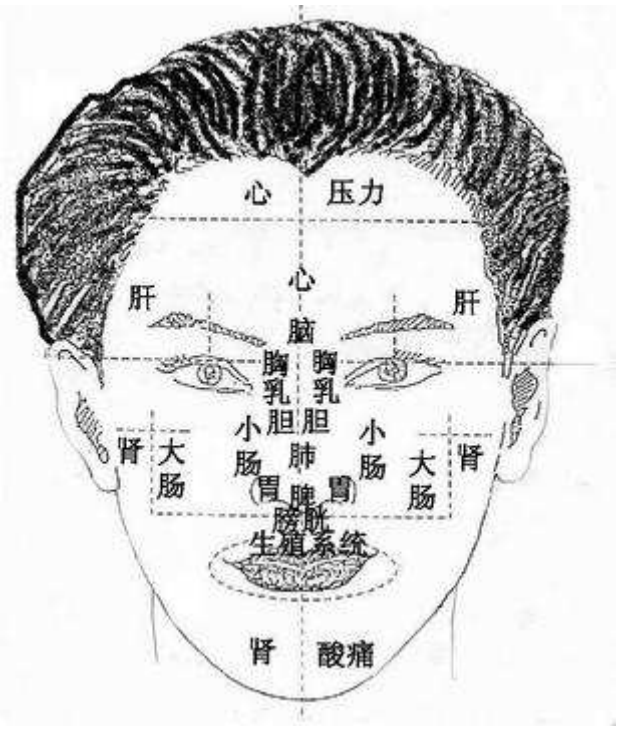


圖 9. 面診部位圖


圖 10. 面診部位網頁圖

指甲為臟腑氣血之外榮，與人體之臟腑經落有直接聯繫，能充分地反映人體生理、病理變化，透過觀察指甲形狀、大小、顏色、光澤、紋路、斑點可判定一個人健康狀況，稱為望指甲。

望指甲教學內容（參見**圖** 11）主要簡介望指甲起源、歷史發展與望指甲相關理論，包含概要、發展源流、傳統文獻、著名醫家、望指甲內容、望指甲紀錄表與相關內容，所有項目均有「經專家判讀之範例影像，」望指甲圖像共計 8 張圖像（參見**圖** 12）；概要簡述指甲於望診重要性及各種型態所代表意義；發展源流說明望指甲由西漢至現代演進變化，針對各時期詳細介紹，傳統文獻蒐羅歷代望指甲著名醫書，於望指甲理論中參考各部文獻之內容；著名醫家由西漢至明清計有王叔和等十九位，除有醫家基本介紹，另附上對應圖片供作參考。

望指甲內容包含指甲構造（參見**圖** 13）、指甲與指爪對應疾病關係、指甲與臟腑氣血、指甲望診之意義、望指甲診病法、望爪法六大部分；構造簡介指甲三大部分：甲根（甲基）、甲蓋（甲體）、指甲前緣（指尖），包含指甲周圍相關部位解釋及影響指甲生長速度因素，檢附指甲相關構造示意圖，指甲與指爪對應疾病關係以結構、形狀、顏色做為分類，說明如何藉由觀察指甲了解對應疾病或生理特殊徵兆，同時比較健康指甲與患部指甲之差異，指甲與臟腑氣血簡述指甲生長受機體變化關連性，指甲望診之意義說明為何可根據指甲診斷疾病，望指甲診病法分指甲平凹、指甲枯萎、

指甲蒼枯、指甲枯厚堆送、甲床淡白、甲床深紅、甲床蒼白、甲床色黃等八種，指甲表面徵兆描述其臨床意義與建議藥方，望爪法簡述觀察爪甲（指甲與趾甲）形色進行診斷之望診方法，分一般方法、形色與稟賦、正常爪甲形色、色澤主病等四種；望指甲紀錄表為一統一性表格，於望指甲判讀前紀錄受測者相關資訊，判讀表格記錄指甲影像判讀完畢之結果；相關內容蒐羅望指甲理論所參考之研究資料，包含論文、專利、文獻、網站、中英書籍、歷年中醫師檢定、考題及研究計畫。


圖 11. 望指甲理論

圖 12. 望指甲範例影像


圖 13. 望指甲部位網頁

皮膚是人體最外層表皮，有保護臟腑功能，觀察皮膚之色澤、形態、紋理、毫毛可反應肺氣寒熱虛實與氣血盛衰，藉由診斷皮膚不僅可得知疾病所在，而且可推斷發病時間長短與病情輕重，稱為望皮膚。

望皮膚教學內容（參見圖 14）主要簡介望皮膚起源、歷史發展與望皮膚相關理論，包含概要、發展源流、傳統文獻、著名醫家、望皮膚內容、望皮膚紀錄表與相關內容，所有項目均有「經專家判讀之範例影像」，望皮膚圖像共計 6 張圖像（參見圖 15）；概要簡述皮膚於望診之重要性，並簡介各種型態皮膚代表意義與其病形；發展源流說明望皮膚由西漢至現代演進變化，針對各時期詳細介紹，傳統文獻蒐羅歷代望皮膚著名醫書，於望皮膚理論中參考各部文獻之內容；著名醫家由西漢至明清計有張仲景等十九位，除有醫家基本介紹，另附上對應圖片供作參考。

望皮膚內容包含皮膚構造（參見圖 16）、望色之要、望皮膚診病法三部分；構造分皮膚構造與功能、皮膚膚色與膚質、皮膚老化三部分，皮膚構造與功能分別介紹表皮、真皮、皮下組織之特性與功能，皮膚膚色與膚質針對皮膚表面兩大特徵：「膚色」與「膚質」做介紹，皮膚老化說明年齡增長後於皮膚產生之各種變化與特徵，望色之要簡述皮膚顏色於歷代望皮膚重要性與其代表意義，望皮膚診病法根據皮膚損害、觀診分佈與實驗方法描述望皮膚如何發現可見與不可見之皮膚徵兆並斷定病症，望皮膚紀錄表為一統一性表格，於望皮膚判讀前紀錄受測者相關資訊，判讀表格記錄

皮膚影像判讀完畢之結果；相關內容蒐羅望皮膚理論所參考之研究資料，包含論文、專利、文獻、網站、中英書籍、歷年中醫師檢定、考題及研究計畫。


圖 14. 望皮膚理論

圖 15. 望皮膚範例影像


圖 16. 望皮膚部位網頁

中醫望診學習與評量系統（參見**圖** 17、**圖** 18）透過網路及電腦數位影像技術，提供傳統望診理論、範例影像、專家判讀結果，視學習進程施加個人化評量，有助於望診循標準化之客觀判別程序，提高中醫臨床應用價值；沒有時間、數量、大小、或是地點限制，不論何時何地，只要透過網路，就能取得系統資料庫中所收集之望診數位影像資料，在線上實施自我能力測驗，透過電腦快速計算，不僅節省教師閱卷時間，學生也能夠立即知道考試結果，以針對自己缺點加以改進；對教師而言，不僅能夠幫助教學，也能夠在系統中製作符合自己教學上所需之測驗試題，同時能將試題與其他教師分享，達到資源共享之目標。

評量系統採動態評量方式，透過介紹評量內容與方式給予必要指導或協助，使受試者水準提高，評量過程中提供之協助程度與方式主要經由評量者與受試者之雙向互動結果決定，屬於著重學習歷程與認知改變之評量方式，不僅是要評估受試者「目前」表現水準，同時企圖瞭解受試者如何達到目前水準以及受試者「可能」達到之水準，動態評量兼顧學習結果評估與學習歷程之剖析，具有回溯性與前瞻性，並結合鑑定、分類、診斷與處方等評量功能，跨越多時間點以偵測受試者在表現上之演變；相較於傳統評量封閉式題目過分標準化之施測過程與量化評量結果，動態評量透過不同程度之提示與給分策略或中介訓練，具備準確區辨力與助益力，評量方式人性化，受測者挫折感較低，「因材施教」之動態評量提供更適當學習幫助。


圖 17. 動態評量登入網頁

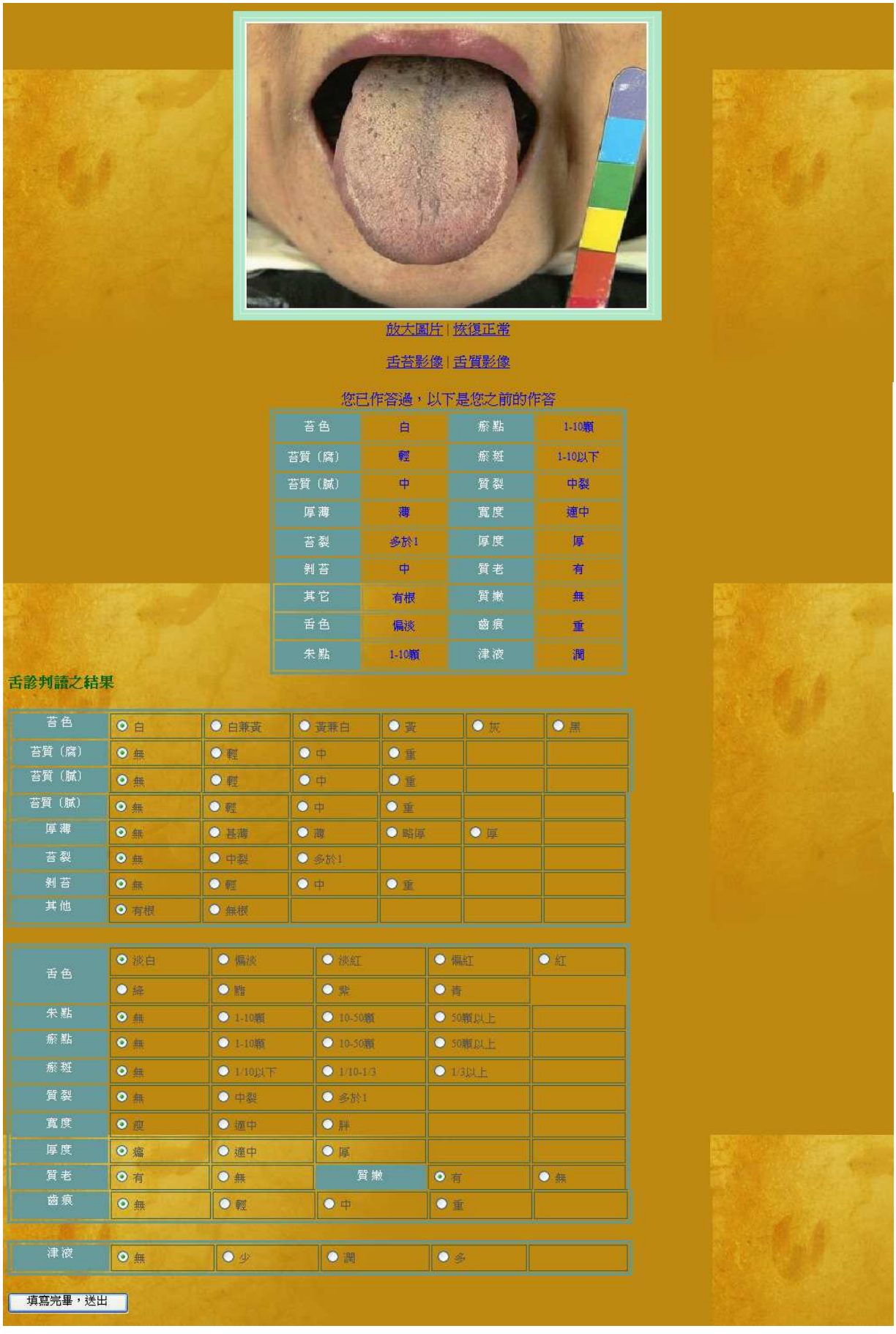


圖 18. 動態評量測驗網頁

而動態評量系統之建置，須建構出動態網頁，即結合資料庫系統(**SQL**)與動態網頁(**PHP**、**ASP**、**JSP**)系統設計。本系統是以 **Microsoft Windows XP** 為作業系統，並以 **WampServer 2.0** 當作網路伺服器，以 **MySQL** 作為系統之後端資料庫，以 **PHP**、**HTML** 等程式語言技術來完成整個系統之程式撰寫工作。

成立望診教學評量系統：

本系統可依照使用者作為分類，可分成學生、教師和管理員等三類使用者；依照系統作為分類，則可分為學生資料管理、題庫管理、學習能力測驗、成績評量、舌診資料庫管理以及系統維護等六樣功能。

一、依照使用者分類：

(一)學生：操作流程如圖（參見**圖** 19），學生可在線上測驗後，了解其錯誤之答題內容及方向，查詢自己成績（參見**圖** 18）。

(二)教師：操作流程如圖（參見**圖** 20），教師可對學生成績進行新增、刪除、修改等動作，對學生下評語或糾正學生觀念，並修改測驗之內容題目及答案（參見**圖** 22）。

(三)管理者：操作流程如圖（參見**圖** 21），可對後端資料庫做新增、刪除、修改等動作，擴大讓資料庫之範疇，修改動態評量等方式，使系統更為彈性、充實（參見**圖** 23、**圖** 24、**圖** 25）。

二、依照子系統分類:

(一)學生資料管理：管理學生之基本資料、帳號、密碼，教師可於線上對學生之資料進行新增、刪除、修改及查詢，選擇特定考試班級、考試人數，查詢學生使用系統情形。

(二)題庫管理：考試題目之範圍、難度、類型及過去之考題經由此系統管理；教師可以製作線上測驗之試卷、試題以及試題轉換、成績處理、試題分析等功能。試題之分析方式，有難度、鑑別度等依據。經過試題分析之後，教師可以得知試題品質良劣，也可間接提昇測驗信度和效度，更可挑選優良試題，建立自己題庫，以供日後使用。

(三)學習能力測試：學生線上測驗之主要管理程式，主要是提供學生透過電腦網路來進行測驗。學生利用瀏覽器即可進行測驗，經自動與預設解答比對，不僅節省教師閱卷時間，學生亦可立即獲知評量結果，以針對自己缺點加以改進，並幫助教師作試題分析，增進命題之技術。

(四)成績評量：查詢參加測驗學生之成績，可顯示學生個人成績。

(五)望診資料庫管理：望診資料庫管理，包含舌診影像資料之建立、資料分析、病歷資料管理皆是由此部分完成，其中共計 181 張舌部影像，此資料庫亦是應用望診電腦化系統於學習能力測驗系統最為重

要之部分。

(六)系統維護：本區將只有系統管理者身份能行使之權力，為使本系統易於維護管理，以及達到遠端管理之功能，因此特別設立「系統維護區」，讓系統管理員在遠端能即時對資料庫進行維護工作。主要是管理系統之後端資料庫。系統管理者也可以透過關鍵字來搜尋，快速地找到資料以便進行資料維護，這些工作都可以透過系統管理者介面來加以管理。

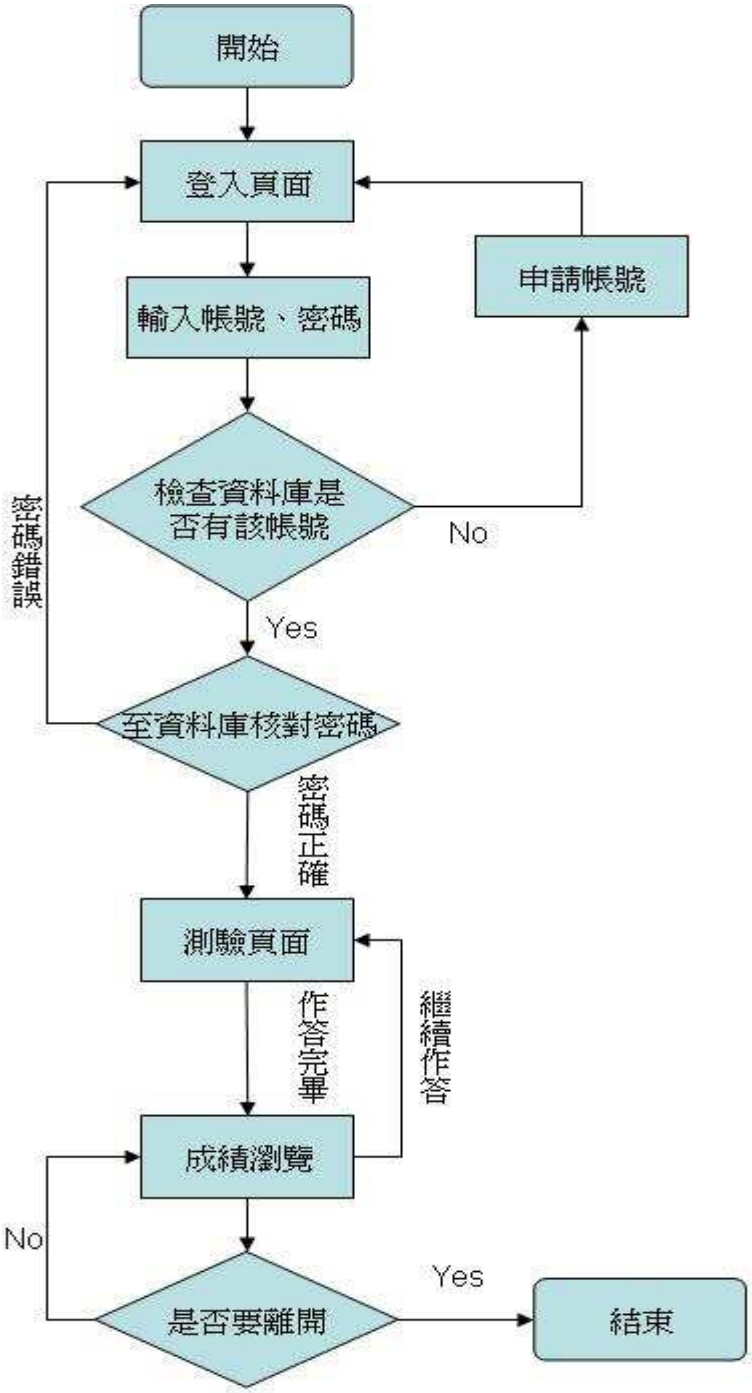


圖 19. 學生操作流程

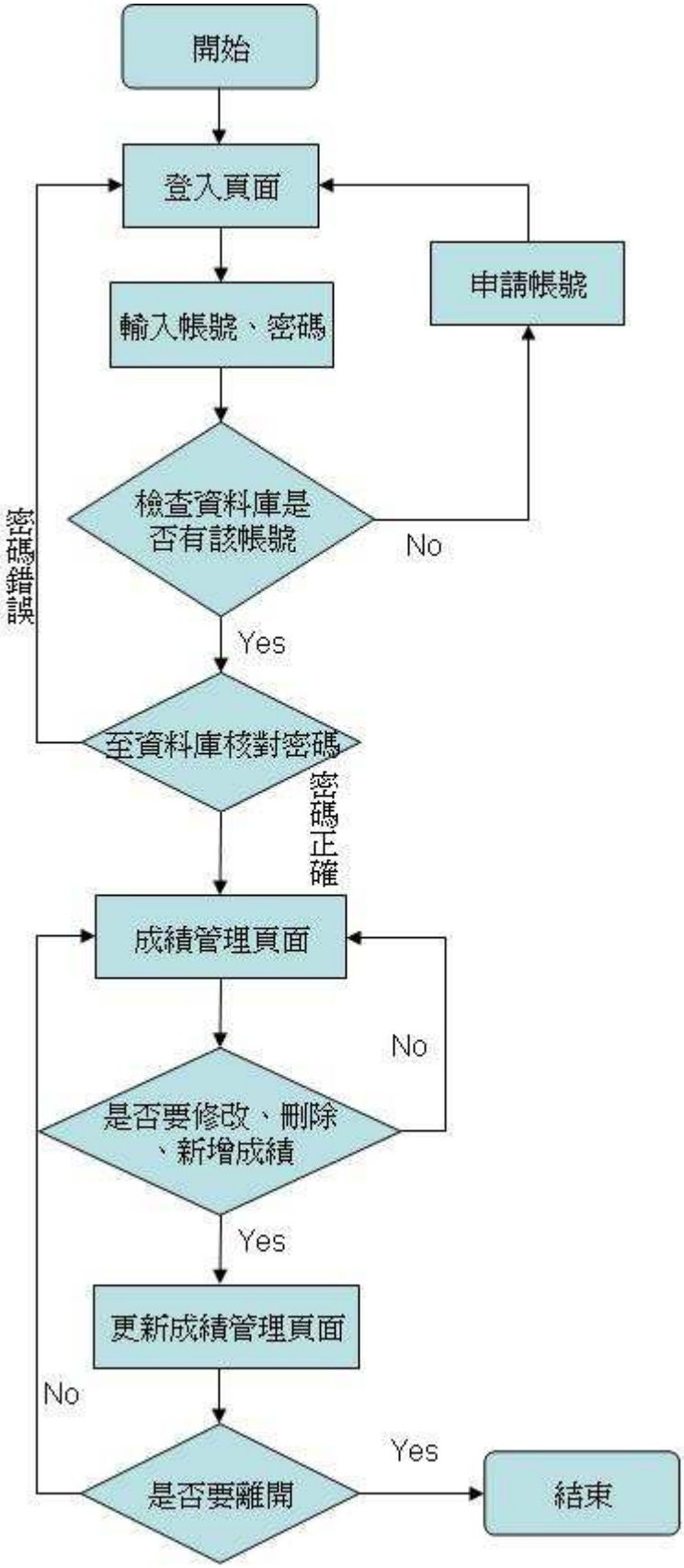
開始
登入頁面
輸入帳號、密碼
檢查資料庫是否有該帳號
No
申請帳號
Yes
密碼錯誤
至資料庫核對密碼
密碼正確
成績管理頁面
No
是否要修改、刪除、新增成績
Yes
更新成績管理頁面
No
是否要離開
Yes
結束

圖 20. 教師操作流程

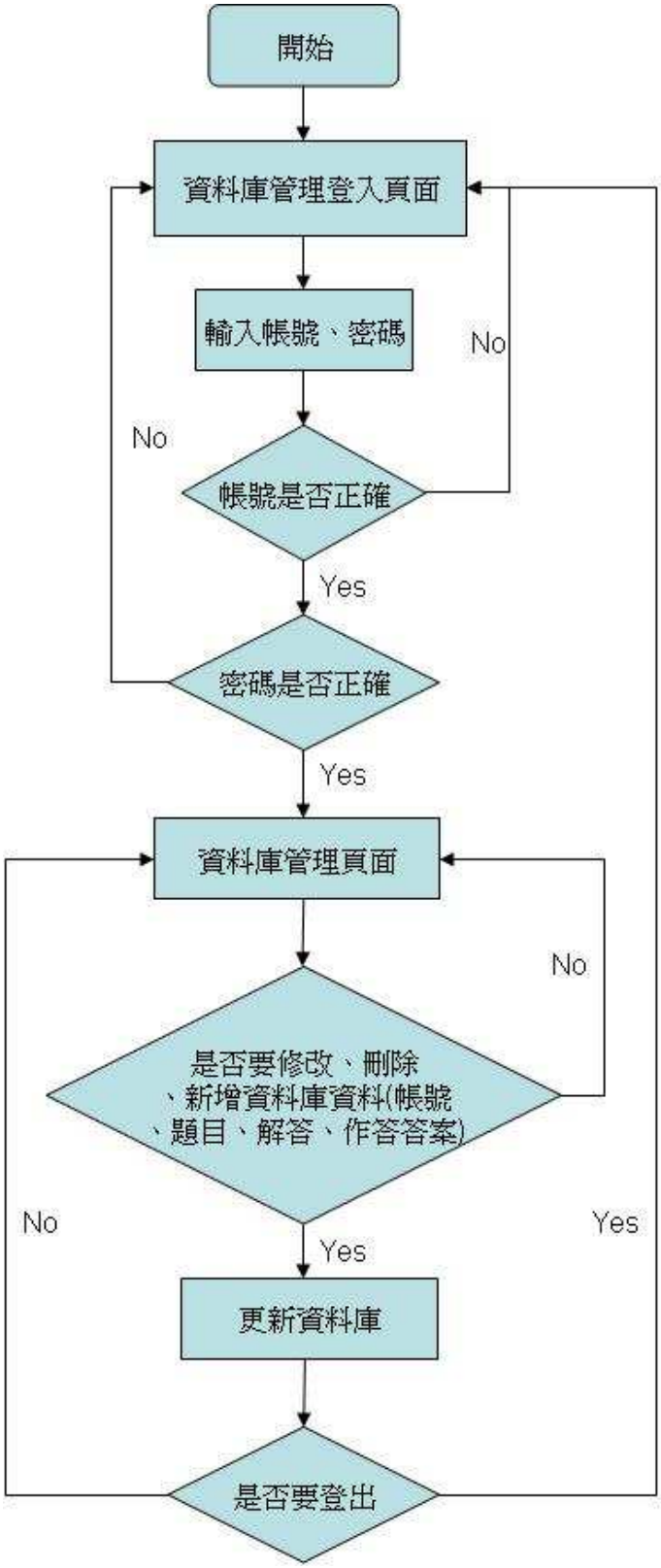
開始
資料庫管理登入頁面
輸入帳號、密碼
No
No
帳號是否正確
Yes
密碼是否正確
Yes
資料庫管理頁面
No
是否要修改、刪除
、新增資料庫資料(帳號
、題目、解答、作答答案)
No
Yes
Yes
更新資料庫
是否要登出

圖 21. 管理者操作流程

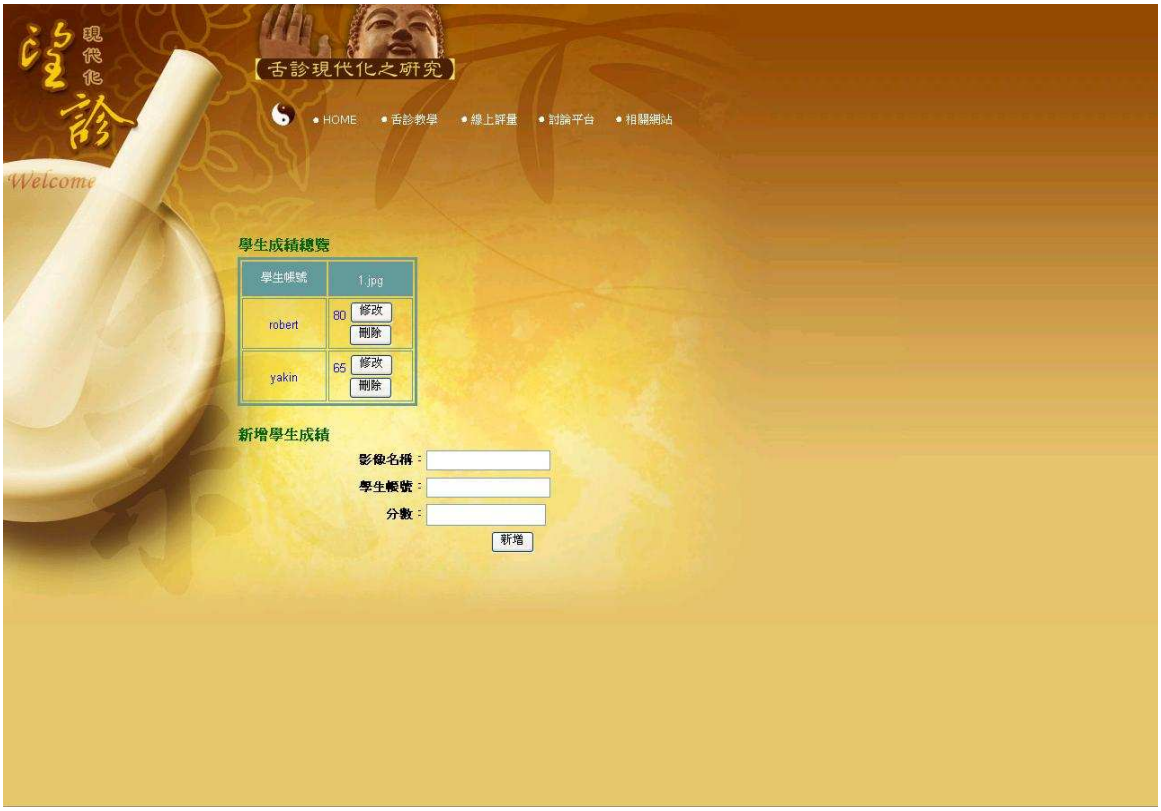


圖 22. 教師管理網頁

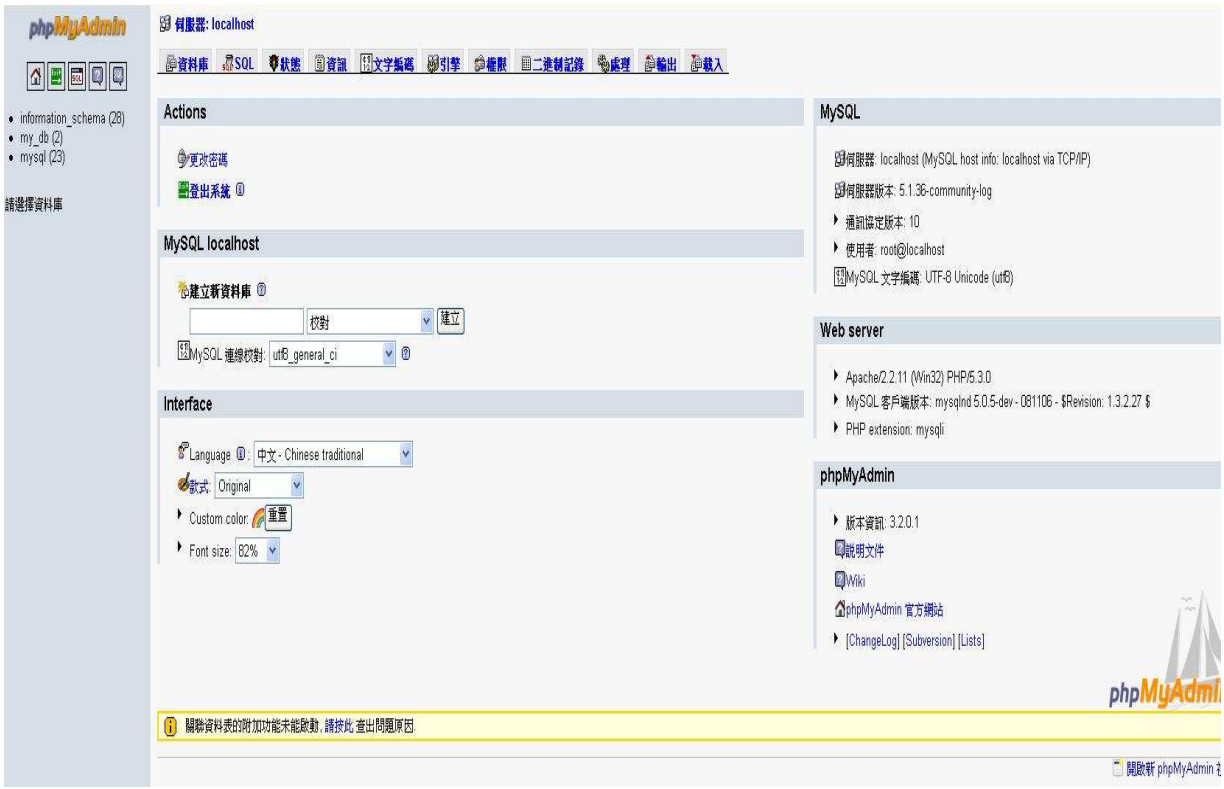


圖 23. 管理者管理網頁：登入頁面

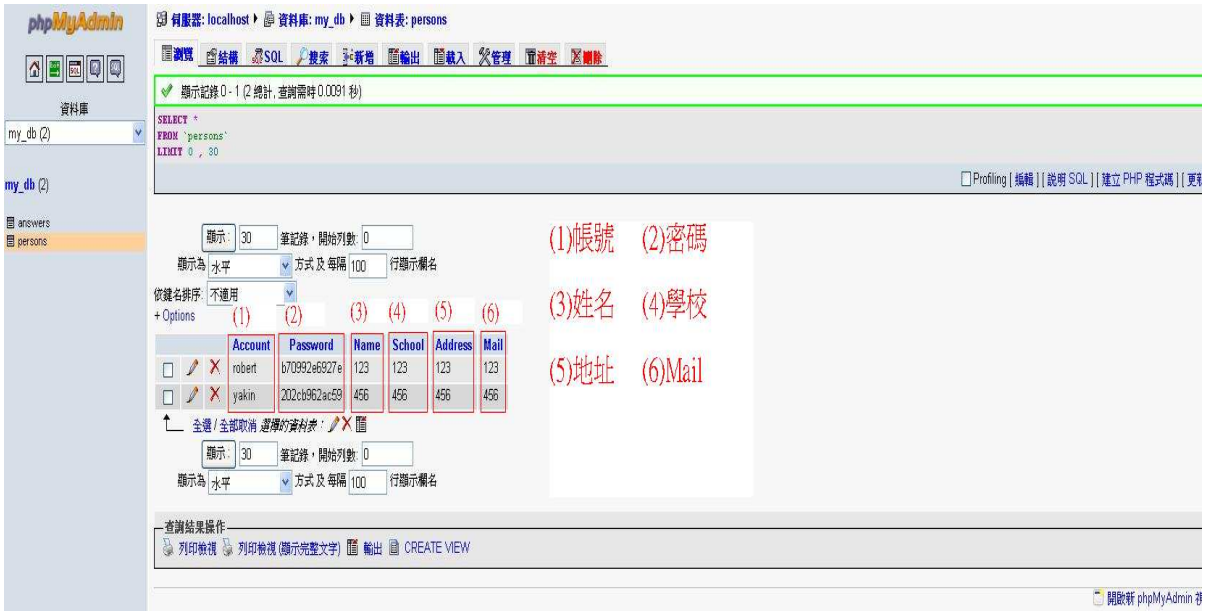


圖 24. 管理者管理網頁：帳號資料


圖 25. 管理者管理網頁：題目與答案

## 參、結果

| | | | |
|---|---|---|---|
| 望診教學與評量系統 | 人眼視覺 | 眼睛結構 | |
| | | 視覺原理 | |
| | | 生理機制 | |
| | | 色彩系統 | |
| | | 色彩管理 | |
| | 望診教學 | 舌診 | 概要：舌頭結構、腑臟劃分 |
| | | | 發展源流：分七個時期（春秋戰國、漢朝三國、晉隋、唐朝、宋金元、明清、民國） |
| | | | 傳統文獻：共 34 本書籍 |
| | | | 著名醫家：分六個時期（春秋戰國、漢朝三國、晉隋、唐朝、宋金元、明清），共 33 位醫家 |
| | | | 內容：舌苔、舌質、舌體 |
| | | | 自動分析：取像環境、分析步驟、舌診影像 |
| | | | 參考資料：73 篇論文、16 項發明專利、26 個相關網站、56 本參考書籍 |
| | | | 舌診紀錄表 |
| | | 面診 | 概要 |
| | | | 發展源流 |
| | | | 傳統文獻：共 11 本書籍 |
| | | | 著名醫家：分八個時期（東漢、西漢、西晉、南朝、隋唐、宋、金元、明清），共 29 位醫家 |
| | | | 內容：顏面與周身關係、望面色診病法、望面容診病法、望面容診之望頭部、望面容診之望五官、望面容診之健康判斷、望面容診之鼻、望面容診之耳、望面容診之眼 |
| | | | 參考資料：9 篇論文、16 項發明專利、26 個相關網站、8 本參考書籍 |
| | | | 面診紀錄表 |
| | | 望指甲 | 概要 |
| | | | 發展源流 |
| | | | 傳統文獻：共 11 本書籍 |

| | | | |
|---|---|---|---|
| | 望診教學 | 望指甲 | 著名醫家：分八個時期（東漢、西漢、西晉、南朝、隋唐、宋、金元、明清），共 29 位醫家 |
| | | | 內容：指甲診病概要、指甲、指爪、與疾病關係、指甲構造、指甲與腑臟血氣、指甲望診之意義、望指甲診病法、望爪甲、望指紋 |
| | | | 參考資料：3 篇論文、16 項發明專利、26 個相關網站、1 本參考書籍 |
| | | | 望指甲紀錄表 |
| | | 望皮膚 | 概要 |
| | | | 發展源流 |
| | | | 傳統文獻：共 11 本書籍 |
| | | | 著名醫家：分八個時期（東漢、西漢、西晉、南朝、隋唐、宋、金元、明清），共 29 位醫家 |
| | | | 內容：望色之要、皮膚構造、望皮膚診病法、望皮膚之健康判斷 |
| | | | 參考資料：1 篇論文、16 項發明專利、26 個相關網站、4 本參考書籍 |
| | | | 望皮膚紀錄表 |
| | 動態評量 | 線上評量 | 查詢個人成績 |
| | | | 線上測驗 |
| | | 討論平台 | 留言版 |
| | | | 佈告欄 |

## 肆、討論

建立望診學習與評量多元化學習管道，蒐羅舌診、面診、望指甲、望皮膚四項研究資料，提供專家判讀之範例影像，佐以近代相關學術論文、書籍及發明，提昇中醫師望診教育廣度及深度，學習系統不受時間地域等限制，透過網路取得相關資訊，並進行自我評量，藉助動態評量「因材施教」之特性可提供適當學習輔助，實踐中醫現代化養成體系。

相關典籍與參考資料之內容收集與整理已完成，未來期望能增加相關內容，加強面診、望指甲、望皮膚三項理論基礎，舌診影像擷取考慮以行動式小型化儀器替代大型取像設備，使用頭帶式取像方式，期望於不同環境下亦能擷取受測者舌頭影像，配合加強之校正程序，以補償取像環境放鬆而導致之失真，為將來進一步研究之參考方針。

## 伍、結論與建議

建置中醫望診學習與評量系統，提供傳統望診理論、範例影像、專家判讀結果，佐以近代相關學術論文、書籍及專利，並視學習進程，施加個人化評量，提昇中醫師望診教育廣度及深度，將有助於望診循標準化之客觀判別程序，獲得可靠斷症結果，提高中醫臨床應用價值；透過現代數位化科技，使用者可經由網路獲得資料庫中望診影像，參考望診理論及專家分析結果而獲得相關知識，達到教學之目標；透過動態評量實施自我能力測驗，學生可針對自己缺點加以改進，不同程度之提示與給分策略或中介訓練，著重學習歷程與認知改變，可以細分學生學習成效，兼顧學習結果評估與學習歷程之剖析，具備準確區辨力與助益力，不僅節省教師閱卷時間，學生也能夠立即知道考試結果，將可有效提升中醫望診教學之學習成效。運用電腦以動態評量方式輔助教學，協助提供中醫望診教學及評量之進行，取代過去傳統教學弊病，實現遠距教學，營造具彈性之學習環境，改善其評量及培育方式，在教導與學習能事半功倍。

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附件 1

# Digital Learning and Dynamic Evaluation System for Traditional Chinese Diagnosis through Observation

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## Abstract

*"Holism" and "pattern identification/syndrome differentiation and treatment" are two fundamental tenets of Chinese Medicine and are the foundations for modernization of Chinese Medicine for the core objectives of ensuring and enhancing the clinical efficacy. Clinical practice is indispensible in both the theory and application of Chinese Medicine. Traditional Chinese Medicine study relied mostly on accumulation of experiences. Related information is collected from a large number of cases and clinical observations for subsequent analysis, induction, and application. After that, progresses during the treatment are recorded and theory refined to apply in clinical diagnosis. It is a very lengthy process. Simplifying this process for rapid analysis and enhancing its efficiency and performance through computers is the key to modernization of Chinese Medicine. Traditionally, most of Chinese medicine practitioners acquaint themselves with the skills through apprenticeship. Relevant knowledge is passed on through lectures with information written on boards and demonstrations with teaching aids. As the communication technology advances, computer and network technology are applied to help interpret and determine observed diagnostic images with analysis by experts, study related knowledge and conduct self-evaluation [9]. Along with popularization of academic theses, books, and publications in recent years as well as dynamic evaluations as the learning proceeds to fulfill intellectual decision-making and reach better learning effects, The proposed Digital Learning and Dynamic Evaluation system for traditional Chinese Diagnosis through Observation (DLDEDO) is adapted to the diverse aptitudes of different students with accurate differentiation and more adaptive learning assistance. DLDEDO assists doctors with disease diagnosis and meets the demands of the education process of the modern Chinese Medicine. The dynamic evaluation also provides future users with diversified learning resources and learning channels.*

***Keyword:*** *modernization of Chinese Medicine, observed diagnostic images, dynamic evaluation*

## 1. Rationale and Purpose

Chinese diagnostics features "pattern identification/syndrome differentiation and treatment", which is based on four ways of diagnosis, i.e. observation, listening and smelling, inquiry, and palpation. These four ways of diagnosis begin with observation, i.e., to collect relevant information on the disease through inspecting the patient. Digressions in the color of certain parts of the human body are closely linked to the causing diseases. The external lively behaviors of a human being are results of the activities of internal organs. When organs dysfunction or disorders occur, external signs and symptoms will emerge on the host (human being). Therefore, by studying these external signs and symptoms, abnormalities experienced by internal organs can be derived. Once the signs and symptoms of a disease on the body surface are located, the degree of lesion in internal organs will then be inferred and analyzed. Therefore, through visual observation, doctors can give patients preliminary diagnoses.

Observation is based on the knowledge and experience of the doctor, who will inspect the coloration and constituents of different regions with naked eyes and determine major diseases suffered by the patient. Diagnoses based on pattern identification/syndrome differentiation and treatment are susceptible to subjective judgments made by the doctor due to his/her personal knowledge, thinking

pattern, diagnostic skills, experience, perception to colors and interpretation, and are not likely to be repeatable because different doctors may reach dissimilar conclusions. They also lack objective and reliable evaluation indexes. In this paper, we proposed employing the computer technology during the observation training process of a Chinese Medicine doctor. The computer combines the traditional inspection theory and contains a pool of images of the tongue, face, fingernail, and skin as well as results of expert analyses that can support diagnosis through observation. The Digital Learning and Dynamic Evaluation system for traditional Chinese Diagnosis through Observation (DLDEDO) established provides traditional inspection theory, exemplary images, and expert interpretation results along with recent related academic theses, books, and patents. In addition, it gives personalized evaluations based on each individual's learning process in order to enhance the broadness and depth of the inspection education for Chinese Medicine doctors. It will help the inspection diagnosis follow standardized and objective determination procedures for reliable diagnostic results and augment the clinical application value of Chinese Medicine. Through modern digital technology, users can access images in the database through the network and refer to inspection theories and results of expert analyses to enrich related knowledge and fulfill the teaching objective [4~5]. By means of self competence tests through dynamic evaluations, students can work on areas that might require further study. The learning process and cognitive developments are emphasized through giving different details of hints, scoring strategy and re-education. The learning efficacy of students can be further scrutinized and enhanced. Both evaluation of learning results and analysis of the learning process are taken into consideration for accurate differentiation and assistance. It not only saves the time spent by teachers in grading but also enables students to be informed of their test results immediately. It will significantly enhance the learning efficacy of students in the inspection diagnosis class of Chinese Medicine.

## 2. Introduction to the System

The DLDEDO contains a multi-tier distributed database server connected to the World Wide Web. System maintenance and update can all be done at a remote terminal via the network, saving time and promoting efficiency.

Internet teaching refers to the fact that teaching objectives and learning activities have shifted from traditional classrooms to the Internet. With the Internet as the medium, content of the course is sent to distant learners and students employ the information technology to facilitate the learning process [6]. The interface design of the system is profoundly influential for the learners in terms of their learning experience and efficacy [7]. The interface of the DLDEDO consists of two parts, the user and the teacher interfaces. The user interface is the communication channel between the system and the user, which includes items that communicate with the system and provide system functions. The teacher interface is the element that assists learners during the span of learning activities. A well-designed interface will enable the learners to focus on the learning content instead of how to operate the system. For the most part, the design principles for the Internet teaching system are derived from those of man-machine interactions. The two major categories are the flow process design and evaluation of the user experience [8]. On the other hand, the top five principles in the design of a teacher interface are that the usage efficacy (content, format, interaction, and overview) is more important than the visual layout, clear press buttons and instructions, simple and easy operation, reasonable browser connection speed and download time, and enhanced user communications.

Contents of the DLDEDO cover three major aspects, human vision, teaching of inspection diagnosis, and dynamic assessments. In human vision, structures of the eye, principle of vision and physical mechanism, including the color system and color management, are briefly introduced. The materials in inspection diagnosis can be classified into four theories (the tongue diagnosis, face diagnosis, inspection of fingernails and inspection of the skin) and four types (notable humans, things, events, and references). Information on doctors, history and development, research content, and related literature is gathered and refined. The teaching evaluation system is developed, with the help of computer network and digital image technology, to fit the diverse aptitudes of different students. It is based on the traditional inspection diagnosis theory, and contains inspection diagnostic images already interpreted by experts and incorporates dynamic assessment methodology. The DLDEDO framework is shown in Figure 1. The following subsections introduce the three major aspects of the system, namely, human vision, the four theories of the inspection diagnosis, and teaching evaluations, respectively.

### 2.1. Human vision

Inspection diagnosis is proceeded by collecting related information on the disease through visual observation. Therefore, eyes play a pivotal role in inspection diagnosis. Understanding the principles of how to appropriately interpret the signals sensed by eyes, factors affecting image formation inside the eyes, and the eyes-brain physical mechanism is vital to the consistent inspection diagnosis. Digital images are generally expressed in three color components. Therefore, to have a preliminary understanding of the images perceived, it is necessary to acquaint oneself with the definition of the color system and relationship between human vision and the color system.

The part on human visual system comprises structure of the eye, principle of vision, and physical mechanism. In addition, it also covers common color systems and color management. The eye structure portion includes the surrounding wall of an eye ball and content of the eye. Simple introduction is given on the composition of a human eye and functions of its internal tissue with pictures illustrating the structure of human eyes. The principle of vision encompasses formation of vision, activities of the eye, and three-dimensional vision. In formation of vision, it briefly describes the process that human eyes capture and send image signals to the brain and the relationship between vision and photography. In addition, it also introduces the functionalities of cone cells and rod cells in the retina. Activities of the eye narrate the five patterns of activities eye balls are engaged in, namely, saccade movement, pulse generator, pursuit movement, vestibular movement, optokinetic movement, and staring, all exercised through the six types of ocular muscles (musculus rectus lateralis, musculus rectus medialis, musculus rectus superior, musculus rectus inferior, superior oblique muscle, and inferior oblique muscle). The three-dimensional vision explains 3D images perceived through human eyes and fundamental concepts of binocular parallax. In terms of the physical mechanism, it discusses the special inborn conditions of human eyes that result in misguided judgments, including visual sensitivity, visual persistence, and visual illusion, with related examples and illustrations. Three color systems, namely, RGB, YUV, and CMYK, are discussed. The corresponding definitions are given and comparisons between different color spaces are made. Color management details two common color correction techniques [10], gamma correction and white balance. Gamma correction is a mechanism that adjusts the brightness of colors in the center of the spectrum while white balance is the correction standard for the color white associated with, e.g., a camera, so that human eyes can function like a camera to adapt to different colors. The Hue Test provides an effective evaluation of an individual's color sensing and inspection capabilities. In addition, in light of the fact that color consistency might be affected by the surrounding environment, color correction card is added when collecting images from a subject. Introduction is also given on the standard color card herein. At last, commercial color management products like X-rite ColorMunki and Spyder 3 Studio that correct color both on the screen and output device for enhancing color accuracy are also presented.

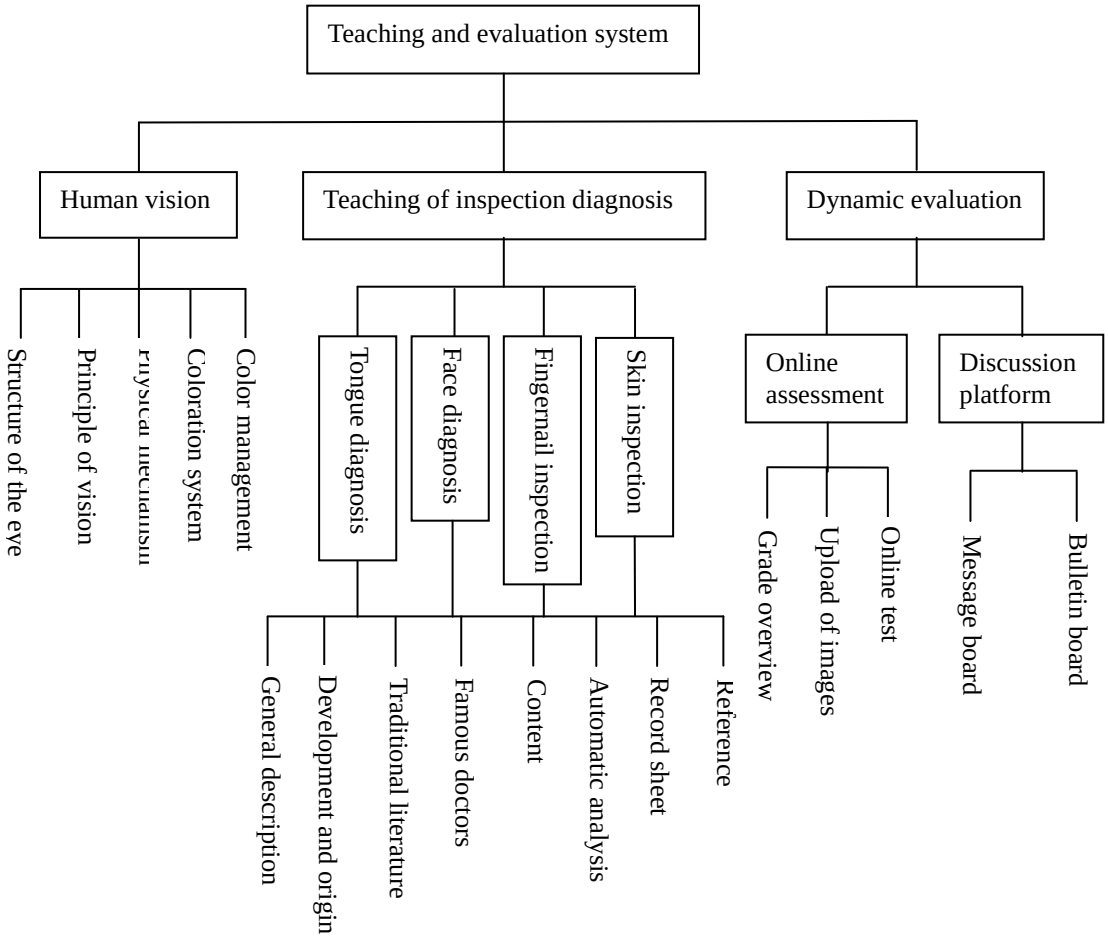


**Figure 1. System framework**

## 2.2. Theory of tongue diagnosis

The tongue is considered as a mirror reflecting the current status of internal organs in a human body. Visible symptoms surfaced on the tongue can be traced to relevant diseases. By observing the tongue,

the cold and hot deficiency and excess associated with lesions of internal organs and severity of a disease can be inferred. Therefore, inspection of the tongue plays an important role in Chinese Medicine. It is referred to as the tongue diagnosis.

Contents of the tongue diagnosis teaching consist of the origin of tongue diagnosis, historical development, and study of tongue diagnosis. The lecture includes brief introduction to tongue diagnosis, its origin and development, traditional literatures, renowned doctors, contents of tongue diagnosis, automatic analysis and related materials. In this ongoing study, a total of 164 tongue images were collected (*ref*. Figure 2 for fissured tongue). Each image has been interpreted by a group of experts with diagnosis agreed by all. Conclusions of the tongue diagnoses are then employed to train a computer to simulate similar interpretation and analysis procedures. Importance and clinical significance of tongue diagnosis is briefly described and so are the main contents of tongue diagnosis in Chinese Medicine. The structure of the tongue thoroughly covers terminology of different parts of the tongue, e.g. the four external (genioglossus, hyoglossus, styloglossus and palatoglossus muscles) and internal muscles that comprise the tongue and the bottom of the tongue, including the frenulum of tongue that looks like a thin film and attaches to the bottom of the oral cavity and papillary bulged taste cells, i.e. taste buds. In organs, the close relationship between the tongue and organs, and how the status of the organs can be observed through the tongue by means of vessels and pulses connecting the two are discussed. From the tip to the root of the tongue are the upper, middle, and lower energizers, by which order, the correlation between different parts of the tongue and organs like the heart, lungs, livers, bladders, spleens, stomach, and kidneys is elucidated. A graph illustrating the relationship between the structure of the tongue and its corresponding organs is also included (Figure 3). The history of development delineates the origin of tongue diagnosis. From the very beginning of the practice, many dynasties have passed, including the Warring States Period, Three Kingdoms of the Han Dynasty, Sueijin, Tang Dynasty, Songyuanjin, Mingcing, and the modern age. Each period is thoroughly introduced. Finally, the evolution of “tongue” character throughout the centuries is presented. The system database contains 32 volumes of traditional literatures on topics of vessels and pulses, which can be searched in the inspection diagnosis teaching system through “text search” and theories on tongue diagnosis can be referenced regardless of the current browsing page. In addition, the legends of eminent doctors, mentioned in the literatures, are organized according to era of their existence. There are a total of 32 renowned doctors, including Bianque. Other than narrating their legacies through words, portraits are also enclosed for reference.

**Figure 2. Fissure tongue**

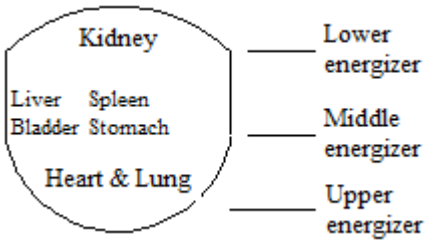


**Figure 3. Areas of the tongue and their respective corresponding organs**

Contents of tongue diagnosis concisely introduce areas of the tongue to be diagnosed. It describes in details and displays all possible surface conditions, aided by clinical images associated with the tongue fur, tongue mass, and tongue body, including color of the fur, essence of the fur, color of the tongue, appearance, morphology, and changes to the tongue [12]. Based on the color of the tongue fur, it can be thin pale fur, thin pale enteromorpha, thick pale enteromorpha, thick pale slimy fur, yellow tongue fur, yellow slimy fur, yellow dry fur, thin yellow tongue fur, burnt yellow tongue fur, gray tongue fur or black tongue fur. The tongue mass can appear thick/thin, wet/dry, grimy/slimy, scaly/peeling, partial/wholesome, true/false. Color of the tongue can range from pink, pale, red, crimson, to purple. In terms of the essence and spirit, it can be luxuriant, withered, tough, and tender-soft. In terms of morphological features, there are the size of a tongue, the rigidity of a tongue body, deviated tongue, shaking tongue, and retractable tongue. For the variations, there are the normal tongue, fissured tongue, enlarged tongue, tongue bearing dental impressions, dark purple tongue, pale tongue with scant liquid, pale tongue with bruises, pale tongue with glow, pale and humid tongue, bright red fissured tongue, bright red white-dotted tongue, pale and old tongue, bright red and dry tongue, bruise-dotted tongue, red-dotted tongue, and sublingual collateral vessels. Among them, sublingual collateral vessels, integral with the tongue mass and tongue fur, provide valuable information to the tongue diagnosis. The observation of sublingual collateral vessels is focused on the morphology of deep lingual veins (dark purple, engorgement, nodes, and edema) on the dorsum of tongue. Because sublingual collateral vessels are clear and not covered with skin, it is easier to make preliminary judgment regarding the physical condition of the patient based on them. The automatic analysis introduces how the modern tongue diagnosis computer system captures images of the tongue, including the image capturing setup, analytical procedures, pre-process questionnaires, and diagnosis report [11] and finally the download and upload of images obtained from tongue diagnosis. In the image capturing setup, factors that may influence picture-taking of tongue images are listed, including color temperature, type and layout of light source, digital camera, exposure, and surrounding environment. Color calibration cards are placed on both sides of the tongue to facilitate the adjustment and correction of possible color deviation during the image capturing process. The analytical procedures provide detailed processing flow for analyzing a

subject's tongue image in sequence [13]. The steps start from overall analysis, detection of the rectangular section, increase of image contrast, image binarization, boundary detection, separation of tongue mass and tongue fur, to the extraction of features. The pre-process questionnaire, part of standard operation procedure (SOP), is a form tabulating possible external factors that might affect later classification of tongue image. Before taking the tongue images, information about the subject, including the check date, indoor temperature, dietary temperature, time and content of the most recent intake (food, beverage, medication), is gathered to have a preliminary understanding about the subject. The interpretation section of the form records results after auto-diagnosing tongue images. The original images and features identified are displayed side by side for ease of comparison. The content encompasses relevant information for tongue diagnosis, including theses, patents, literatures, websites, Chinese/English books, past Chinese Medicine Practitioner's test questions, general test questions, and research projects.

## 2.3. Theory of face diagnosis

Inspection of the face has been an important part in the theory of Chinese medicine since several thousand years ago. It is one of the four ways of examinations, namely inspection, listening and smelling, inquiry, and palpation. When human health is undermined, visible symptoms will start to appear on the face. The technique of observing specific areas of the face which reflect the functionality of the corresponding organs, such as the heart, lungs, liver, kidneys, spleen, small intestines, large intestines, and reproductive organs is referred to as face diagnosis.

The contents regarding the teaching of face diagnosis include a brief introduction to the origin of face diagnosis, historical development and theory of face diagnosis. The general description, development and origin, traditional literature, eminent doctors, contents of face diagnosis, standard report of face diagnosis and recorded contents are listed. All items are supported by exemplary images that have been interpreted and agreed upon by a group of experts. In the general description, the importance of face diagnosis and the relationship between areas on the face and internal organs, including local special signs and color digressions, are described with inclusions of pictures of corresponding organs in face diagnosis. The development and origin delineates the evolution of face diagnosis from the Western Han Dynasty to the modern age and earmarked with milestones of each period. Literatures collect information about renowned doctors in the history of face diagnosis. In the theory of face diagnosis, contents of different literatures are referenced. There are 19 famous doctors from the Western Han Dynasty to Ming and Cing Dynasties, including Yu-yi Chun. Besides the basic profile of the doctors, portraits are also available for reference.

Contents of face diagnosis encompass the relationship between the face and the whole body, disease diagnosis through inspection of the facial complexion, and disease diagnosis through inspection of facial expression. In terms of the relationship between the face and the whole body, it includes the face, internal organs, and the six highlights/two points related to face inspection diagnosis. In the face and internal organs, areas on the face and their corresponding internal organs and the relationship between the two are thoroughly described. By linking the relationship between the internal organs and their corresponding areas on the face, it will help locate general area of the lesion and subsequent verification will only have to pinpoint the exact position to give judgment of the disease. The six highlights of face inspection diagnosis depict areas that signs of disease show, including the internal, external, upper, lower, left, and right areas and their dynamic developments. At the same time, contents of "Inspection Diagnosis Guidelines" are referenced. Disease diagnosis through inspection of facial complexion comprises pinpointing the origin of the disease by observing the complexion, five colors for main diseases, understanding the severity of disease by inspecting the face, knowing condition of the disease by inspecting the face, and predicting disease prognosis by inspecting the face. Based on the five colors and organs principle, lesions of different organs may result in varied disease complexions. Therefore, diseases with different natures and symptoms are coupled to the corresponding facial complexions. Disease diagnosis through inspection of facial expressions includes acute fever expressions, chronic exhaustive expressions, pulmonary tuberculosis expressions, mitral valve stenosis expressions, Cushing's syndrome expressions, seizure smile expressions, masked facial expressions, acromegaly expressions, narrow cheek expressions, systemic lupus erythematosus expressions, lion face expressions, hyperthyroidism expressions, mucous edema expressions, facial palsy expressions, rigid temporomandibular joint expressions, anemia expressions, dehydration expressions, typhoid fever expressions, Addison disease expressions, liver disease expressions, and critical condition expressions. For each of them, the significance of different facial expressions and the corresponding treatment methods with related regimens are listed for reference. The report sheet for face diagnosis is a formatted template. It tabulates related information about the subject before interpretation of face diagnosis. The interpretation template records results after diagnosing face images. The relevant materials encompass study information referenced for face diagnosis, including theses, patents, literatures, websites, Chinese/English books, past Chinese Medicine Practitioner's test questions, general test questions, and research projects.

## 2.4. Theory of fingernail inspection

Fingernails, with collateral vessels that directly connected to internal organs of a human body, represent external manifestation of internal qi and blood circulations. The physical and pathological changes inside the body are fully reflected through fingernails. By observing the shape, size, complexion,

glow, and grain of fingernails, the status of one's health can be determined. The technique is referred to as fingernail inspection.

The teaching of fingernail inspection primarily encompasses a brief introduction of the origin of fingernail inspection, its historical development and theory of fingernail inspection, namely, general description, development and origin, traditional literature, famous doctors, content of fingernail inspection, fingernail inspection report sheet, and related materials. All items come with exemplary images that have been interpreted and agreed upon by a group of experts. In the general description, the importance of fingernail inspection and implications of various morphologies are described. Development and origin deal with evolution of fingernail inspection from the Western Han Dynasty to modern age, in which each period of evolution is introduced in details. Traditional literature collects famous publications on fingernail inspection that can be referenced throughout the system. There are 19 eminent doctors from the Western Han Dynasty to Ming and Cing Dynasties, including Shu-he Wang. Other than a basic profile for each doctor, there are also reference pictures available.

Contents of fingernail inspection include structure of the fingernail, relationship between fingernails, toenails and their corresponding diseases, fingernails and qi, blood in internal organs, significance of fingernail inspection, disease diagnosis through fingernail inspection, and method of toenail inspection. The structure of the fingernail briefly introduces the three parts that comprise the fingernail, namely, radius unguis (base), top of fingernail (body), and the front end of the fingernail (fingertip), and explains regions around the peripherals of the fingernail and factors that affect the growth of the fingernail, with enclosure of pictures that demonstrate structures of the fingernail. The relationship between fingernails, toenails and the corresponding diseases is described by the structure, shape, and color. It explains how to uncover diseases or special physical signs by observing fingernails. The differences between healthy fingernails and fingernails with lesions are also compared. Fingernails and qi, blood in internal organs delineates the connection between the growth of fingernail and functionalities of organs. Significance of fingernail inspection explains why one can diagnose diseases by observing the fingernails. Disease diagnosis through fingernail inspection is divided into flat/dented fingernails, withered fingernails, dry fingernails, thick and accumulated fingernails, pale nail beds, dark red nail beds, white nail beds, and yellow nail beds. Surface signs of fingernails state their clinical significance and suggested regimens. Method of toenail inspection covers the inspection methodology by observing color and shape of nails (fingernails and toenails). It is divided into the general method, shape/color and gifts, the normal shape and color of nails, and colors-dependent major diseases. The report sheet for fingernail inspection is a formatted template. It records related information about the subject before performing fingernail inspection. The interpretation template records results after interpreting fingernail images. The contents encompass study information referenced for fingernail diagnosis, including theses, patents, literatures, websites, Chinese/English books, past Chinese Medicine Practitioner's test questions, general test questions, and research projects.

## 2.5. Theory of skin inspection

Skin is the outermost layer of the human body. It can protect internal organs. Complexion, morphology, grain, and vellus hair of the skin will show the status of pulmonary qi and blood circulation. Therefore, skin inspection not only leads to identification of disease but also helps with inference of the span and severity of the condition.

The teaching of skin inspection primarily comprises a brief introduction of the origin of skin inspection, its historical development, and theory of skin inspection, namely, general description, development and origin, traditional literature, renowned doctors, contents of skin inspection, record sheets for skin inspection, and related resources. All items come with exemplary images that have been interpreted and agreed upon by a group of skin inspection experts. In the general description, the importance of skin to the inspection diagnosis, significance of different types of skin and the conditions they represent are described. Development and origin narrate the evolution of skin inspection from the Western Han Dynasty to the modern age with detailed depiction of each landmark period. Traditional literature collects historically famous books on skin inspection and can be referenced in the theory of skin inspection. A total of 19 famous doctors are included ranging from the Western Han Dynasty to Ming and Cing Dynasties, among them, Zhong-jing Zhang. Except basic profiles of the doctors, portraits are also available for reference.

Contents of skin inspection encompass structure of the skin, highlights of complexion inspection, and disease diagnosis through skin inspection. The structure of the skin is divided into the structure and functionality of the skin, skin complexion and essence, and skin aging. In the structure and functionality of the skin, the characteristics and functions of the epidermis, dermis and subcutis are introduced. Skin complexion and skin essence, as the name indicates, describe the two features of the skin. Skin aging explains the various changes and characteristics associated with the skin as one grows older. Highlights of complexion state briefly the importance of skin inspection in the history and the significance it represents. Disease diagnosis through skin inspection describes how to find visible and invisible skin signs and diagnose diseases by means of skin damage, inspection area, and experiments. The report sheet for skin inspection is a formatted template. It records related information about the subject before interpretation of skin inspection. The interpretation template records results after interpreting skin images. The related materials cover

study information referenced for skin inspection, including theses, patents, literatures, websites, Chinese/English books, historical Chinese Medicine Practitioner's test question, general test questions, and research projects.

### 2.6. Dynamic assessment

Digital Learning and dynamic evaluation system for traditional Chinese diagnosis through observation provides traditional inspection diagnosis theories, exemplary images, expert-interpreted results through the Internet and digital image technology and evaluations tailored to match personal learning progress. It will help inspection diagnosis to follow standardized and objective judgment procedures, enhancing the on-site clinical value of Chinese Medicine. Not limited by time, quantity, size, or location, users can access the inspection diagnosis digital images collected in the database through the Internet, perform self-competency tests online, which are then quickly graded by the computer, saving teachers time spent in manually grading the tests and enabling students to know their test results in real time in order to work on areas they need to improve. For teachers, it not only helps with teaching but also enables them to design test questions that meet teaching needs while at the same time distributing test questions to other teachers, achieving the goal of resource sharing.

The dynamic assessment system provides necessary guidance or assistance through introduction of the assessment contents and method to enhance the examinee's level. The extent and method of assistance provided in the process of the evaluation are primarily determined by the bilateral interaction between the evaluator and the examinee. It is a type of evaluation that emphasizes the learning process and cognitive development. Not only the "present" performance of the examinee is evaluated, but also how the examinee achieves the present level and the level the examinee may "possibly" achieve is disclosed [1]. The dynamic evaluation assesses and analyzes the learning result at the same time. It is retroactive and prospective and combines different evaluative features, including accreditation, classification, diagnosis, and prescription. It encompasses multiple time points in order to detect the development of the performance of the examinee. Unlike the close-ended questions, over standardized test processes, and quantitative test results associated with conventional assessments, dynamic evaluation features prompts to various degrees and different grading strategies or mediated trainings with accurate differentiation and assistance. The evaluation method is personalized so that the examinee feels less frustration. "Teaching students based on their individual aptitude," the dynamic evaluation provides more adapted learning assistance [2~3].

For first-time users of the system, they must register as "teacher" or "student" role and then use the assigned user account and password to log into the system and operate the system. The system comprises four major parts, teaching of tongue diagnosis, online evaluation, discussion platform and related websites. Tongue diagnosis primarily introduces the history of tongue diagnosis, tongue fur, tongue mass, and tongue body. Equipped with the upload function, users can upload images from a remote terminal. Online evaluation is a learning and test system, which includes grade overview and online tests. Grade overview enables students to inquire their grades. It displays the number of the image, number of tests, test date, and test time. Online tests are given to students with questions from an image database. Each question contains original and color-corrected images. Students have 10 minutes to interpret the images and fill in the evaluation form. In the evaluation form are several options for different characteristics of the lesion. When time is up, the system will send out the information filled and calculate grades automatically. The color of blue will be highlighted on the correct portions and red on the wrong ones. After that, based on the dynamic evaluation design principle, items with wrong answers will be picked out and questions targeting on ones with wrong answers will be prompted for answer. Students can choose by themselves whether or not to take tests with similar questions again so that they can work on weak points requiring reinforcement and consolidate their concepts. The discussion forum includes the message board and bulletin board. Both teachers and students can leave messages on the bulletin board and interact with each other through message sending. Teachers can post important notices on the bulletin board as a way to communicate with students. Related websites include those of domestic Chinese Medicine practitioners and Chinese Medicine files, broadening the access of students to relevant knowledge.

## 3. Conclusion

The inspection diagnosis teaching and evaluation system provides diversified learning channels, collects study information on tongue diagnosis, face diagnosis, fingernail inspection, and skin inspection, and offers exemplary images that have been interpreted by experts, assisted with contemporary related academic theses, books, and patents, enhancing the extensiveness and depth of inspection diagnosis education for Chinese Medicine practitioners. The computerized teaching system is not limited by time or space. Information is accessible through Internet and users can conduct self evaluation. The dynamic evaluation, featuring "teaching students according to their individual aptitudes," can provide adequate learning assistance. It is a cultivation system for modern Chinese Medicine.

At present, efforts are devoted to collection and sorting out volumes and reference information to further enrich the contents of face diagnosis, fingernail inspection, and skin inspection. Smaller

portable equipments are under investigation to replace the current bulky imaging instruments in the hope of acquiring images in a more diverse environment. With a robust feature extraction algorithm developed, images taken can be expected to be reasonably corrected to compensate for the variations caused by a less controlled environment. The results of these on-going researches will be updated timely in the system established.

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