THE EFFECT OF APPLYING ONLINE PBL CASE SYSTEM TO MULTIPLE DISCIPLINES OF MEDICAL EDUCATION

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ABSTRACT
Teaching cases in medical education are often exhibited through various professional angles, but for patient-centered teaching cases, the division of labor among different specialties is even more important. However, general medical education platforms cannot provide such mechanisms for physicians. Thus, this study adopted a clinical medical education platform "HINTS" to establish a patient-centered interdisciplinary medical/clinical education mechanism for medical students to obtain a more holistic thinking process in practical training for clinical medicine. Additionally, rule-based and document-view methods were administered to successfully establish methods to edit and present teaching cases, installing them on "HINTS." The results of the preliminary experimentation show that applying online PBL case system can be very beneficial for the learning effects of medical students.
Keywords: Multiple Disciplines, PBL for medical education, integrated teaching case

INTRODUCTION
Recently many medical schools and centers have adopted a variety of Web-based application systems in an attempt to establish e-learning environments (Holzinger, Kickmeier-Rust, Wassertheurer, & Hessinger, 2009; DxR, 2008; Green, Jenkins, Potter, & Davies, 2000; Richards, 2002; Wong, & Hoo, 1999) for medical education purposes (Alpay, & Littleton, 2001; Dev, 1999; Norris, & Brittain, 2000; Zollo, Kienzle, Henshaw, Crist, & Wakefield, 1999). One such approach has been to introduce Web-based, Problem-Based Learning (PBL) strategies into their training curriculum (DxR, 2008; Maudsley, 2003; Norman, Schmidt, 1992; Oubenaissa, & Giardina, 2002). In the medical field, PBL involves the presentation of clinical cases as a means of learning basic medical and clinical science. In combination with PBL techniques, computers and computer networks can be successfully applied as training tools for physicians or students in medical schools such that they gain the required knowledge and experienceto make accurate diagnoses in their actual clinical practices. In the Web-based PBL systems, students are presented with a challenging medical problem and then retrieve the relevant supporting information from the computer system in order to work their way progressively towards a correct diagnosis. This teaching strategy appears to be reasonably effective, and has been adopted by many website-based teaching case systems available on the Internet (Dornan, Maredia, Hosie, Lee, & Stopford, 2003; DxR, 2008).

However, in this type of teaching system, each teaching case is compiled by an individual instructor working independently. Therefore, the teaching materials can only reflect their particular view of the learning points and may only represent a small portion of the complete picture of the teaching case. As a result, although students experience many different teaching cases from different clinical disciplines during their training, these teaching cases may not be necesary associated with each other. Consequently, it is difficult for the students to relate the learning points gained from one single teaching case to the knowledge acquired from another. Hence, they may struggle to fully develop an integrated multi-disciplinary view and understanding of the clinical knowledge, which they will require in the future clinical practice. Therefore, this study aims to explore how an Web-based PBL teaching case can be presented to the medical school students in such a way that provides an integrated, effective, and efficient mechanism for them to acquire an overall perspective and knowledge of patient care problems.

A prototype system referred to as "HINTS" (Health Information Network Teaching-case System) (Cheng, Chen, Weng, Chen, & Lin, 2009; Chen, Cheng, Weng, Chen, & Lin, 2009) is implemented in this study. This system is an Web-based Problem Based Learning (Web-based PBL) system, which incorporates many actual clinical teaching cases so as to enable the students to acquire an integrated view of the typical clinical cases they will encounter in their future medical practice (Seila, 2000). The basic approach of the proposed system is to take one particular clinical case and to have the various domain experts from the different clinical disciplines edit the related teaching material such that the users can explore the clinical case from a variety of different perspectives. The concept of document-view architecture and a rule-based mechanismare are used in the teaching case system to provide an integrated clinical view of the medical school students' medical e-learning, which is followed by the method of providing an integrated view of clinical teaching cases and introduction to the concept of the document-view architecture for the system implementation. The plain mode and interactive mode of the system operations are also briefly introduced. Then, the system implementation from an author's perspective and an engineer's perspective are discussed. Finally, the reports of the users' experience and the authors' in using and developing the prototype system and conclusion are presented respectively.

BACKGROUND

The Integrated View of Clinical Teaching Cases

Based on our previous argument, if the same Web-based PBL teaching case is explored from the perspectives of different disciplines, students should be able to learn in a more effective and efficient way because the overall picture of the case will be seen in a more integrated fashion. In other words, if all the basic subject materials of a teaching case are related to the same patient case, and different domain experts edit the clinical data from the perspective of their own disciplines, the students can understand how a case is viewed from different perspectives. For the sake of argument, we define some terminologies here. If a teaching case is edited by an internal medicine viewpoint, it can be referred to as "an internal medicine view". Furthermore, the term "a department view" refers to any general view of a teaching case. That is, an internal medicine view is a department view of a teaching case which views the case specifically from the perspective of internal medicine.

Concept of Case Templates and Document-View Architectural Pattern

Case templates

In order to explain how our prototype system was implemented, first of all, the PBL teaching case template concept used in the system is introduced. The PBL teaching case system is essentially a multimedia Computer Aided Instruction (CAI) system (Cheng, Chen, Lin, & Chen, 2003) with knowledge database containing the knowledge of specific topics, which an expert in that particular domain would reasonably be expected to possess. In the system, the knowledge model (Clancey, 1987) contains data related to the many different clinical cases, which are to be taught. Since many teaching cases in the system share similar scenarios, it is possible to use a number of "case templates" (Cheng et al., 2003) to form an abstract model of the domain knowledge. In other words, a template outlines the main contents of a teaching case, and serves as the directory of the case. A template for a typical medical teaching case might include the following sections: (1) basic personal information such as age and gender, (2) brief case history, (3) reported complaints, (4) physical examinations, (5) findings, (6) diagnoses, (7) relevant associated cases, (8) discussions, (9) comments, and (10) learning points.

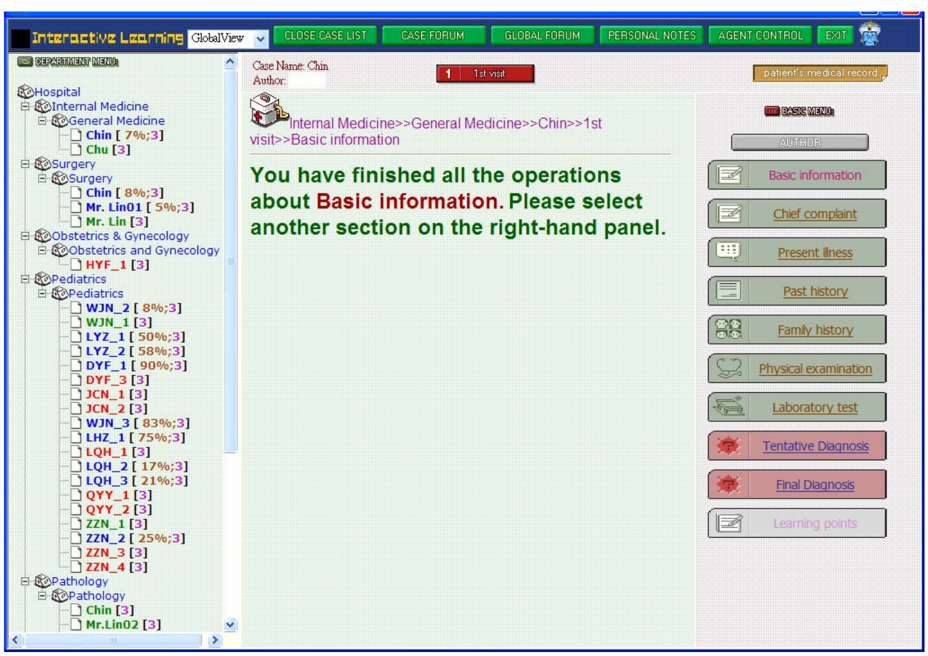
The concept of the document-view

Each department in a hospital has its own clinical data representation semantics for its teaching cases and can be edited to its own teaching case templates, which are suitable as the teaching materials of the department. For instance, for the radiology department, the system has the MRI, CT, or X-ray images (Huang, 1999; Wong, & Hoo, 1999), the basic patient information, such as age, sex, and the patient's chief complaints, etc. Each department has its own emphases and case templates, each of which has specific meta-data to present a specific semantics of a teaching case for the teaching purpose. In general, there are many different department views (perspectives) to look at a teaching case. Within these different department views for the same teaching case, some parts of the case are shared among some department views while some other parts may be used by only one department alone. From a more abstract point of view, the situation is well fitted into the "document-view" architectural pattern (Chang, Chen, & Lai, 1999) in which a document in an interactive system may have many different views depending on what the user wants to be able to visualize the data in hand. The document-view architectural pattern divides an interactive application system into two components. The document component contains the core functionality and data of the object of interest while the view component displays the data of the object of interest to the user and handles user interaction. It can be multiple views of the same document. If the user changes the data of the document, all the views depending on this document should reflect the changes.

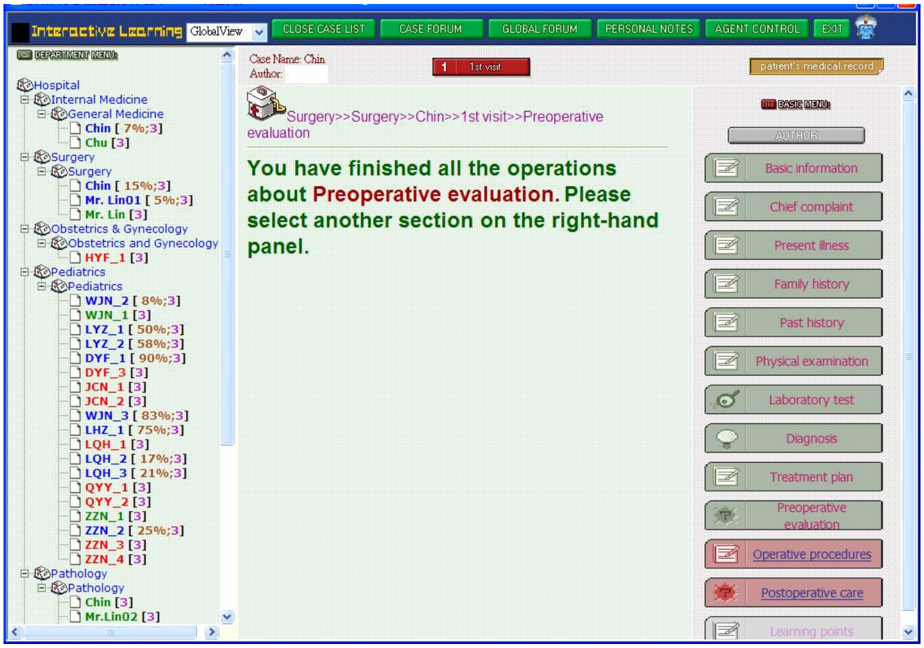
In the implementation, a rule-based mechanism is used to support the document-view concept of the teaching case system. When the user enters the case template into the system using the template-authoring tool, the sections that will be used by at least one department view will be entered into the case template. The user can make use of a rule database for specifying which sections in the case template will be included in a given department view of a teaching case so that when the user browses the case latter, the system can respond accordingly. The rules are encoded in a data format and stored in a database as opposed to some specific rules executed by an inference engine as some expert systems do. The rule database and the implementation details are described in section 3.2.

The Plain Mode and the Interactive Mode of the System Operations

The proposed system makes available two different modes of operation for any given department view. Different students using the system have different academic backgrounds and different learning objectives. The system meets these diverse requirements by providing two different operation modes, namely (1) the interactive mode, and (2) the plain mode. Each mode has its own particular strengths and weaknesses. In the interactive mode, the system provides various datasets to challenge the student, who is then given the opportunity to work his way progressively through the appropriate clinical procedure towards a final diagnosis. This style of interactive learning is both interesting and challenging for students who already possess sufficient knowledge to be able to develop correct answers. However, students who have only recently been introduced to the material covered in the teaching case are unlikely to possess sufficient knowledge to successfully complete the training task. It is little value to oblige these students to guess randomly at the required answers, and they will likely become frustrated if required to operate in such a challenging learning environment. In this case, it is probably preferable to present the necessary teaching materials descriptively so that the students can simply read through the teaching materials. This approach is referred to as the “plain mode”, and in some senses can be regarded as the equivalent of an electronic book where the teaching materials are presented directly. In summary, the interactive mode is more appropriate for advanced users, while the plain mode is designed more with the needs of novices in mind, or for users who are not specialists in that particular knowledge domain.



(a) the view of the internal medicine



(b) the view of the surgery
Figure 1. The system screen layout

SYSTEM IMPLEMENTATION

The system was implemented in Microsoft Internet Information Server using both Microsoft "ASP (Active Server Page).Net", and SQL database technologies. The students can simply use the WWW (World Wide Web) browser to login the "HINTS" system and browse the teaching cases at the computer center in the medical school or at home where wide bandwidth Internet connection is available.

The Authors' Perspective

For a given patient case, we asked several domain experts to edit the teaching case material from their own perspectives. This involves the following steps.

(1) The generation of a case template that can accommodate the needs of all the perspectives. Each domain expert should define his own case template first. All the templates of all the perspectives will be put together to form the overall template of the teaching case. This is because some sections are shared by many different templates of different department views and the system needs to keep only one copy of each section for the consistency control instead of making several copies of the same data and complicating the maintenance work. Therefore, at this step, an overall teaching case template was set up.

(2) Set up a "department-view-rule" database that specifies which sections belong to which department views so that the system can present the teaching case material to the students properly. Each department view has its own case template, which is a subset of the overall case template. All the case templates are recorded in a database called the case template database. For instance, for a case in the system, the sections for the internal medicine case are the basic information, chief complaint, present illness, past history, family history, physical examination, laboratory test, tentative diagnosis and Final diagnosis section while the sections for surgery are Basic information, Chief complaint, present illness, past history, family history, physical examination, laboratory test, diagnosis, treatment plan, preoperative evaluation, operation procedure, and postoperative care. Note that they share the basic information, chief complaint, present illness, past history, family history, physical examination, laboratory test, and diagnosis sections.

Figure 2 illustrates the steps involved in developing a teaching case using the implemented "HINTS" system. Each participating department lists the core topics, and one senior attending physician from that department is then designated as the coordinator of the project.

1. The coordinator identifies the teaching cases and assigns responsible authors for establishing the learning objectives and collecting the information for each case.
2. The coordinator instructs a research assistant to log in to the data-collection process and to register a patient ID, hence triggering the data collection process.

3. The data-collection website automatically sends the data collection request message to four separate units, namely (1) the Computer Center at NCKU hospital, (2) the Department of Radiology, (3) the Endoscopy Laboratory, and (4) Department of Pathology. The proposed system is obliged to inform these individual units since patient data are not integrated within a single large database system. This is because that in almost all hospitals in Taiwan, and in fact throughout the world, patient data tend to be distributed geographically in this way, although this situation is far from the perfect case where all the patient data are integrated into a single large database system. The current implementation has shown that the proposed arrangement functions very effectively in terms of accessing the requested data.
4. Once the messages are received, the assigned research assistant in each unit collects the necessary patient data and then uses "ftp" to transmit them to the data-collection website under a particular directory for each patient.
5. The research assistant retrieves the data from the particular directory, and uses the authoring tools in the "HINTS" system to edit them for the particular teaching case.
6. When the research assistant completes the preliminary draft of the teaching case, it is reviewed and analyzed by the author. The draft is then reviewed by other specialists with specific domain knowledge and modified as necessary according to the learning objectives.
7. If the author is not satisfied with the case template or the presentation model, he can modify them by specifying some new requirements.
8. The research assistant and the engineers develop the software to meet the requirements of the presentation model or the case template. The workflow then returns to Step 5. The research assistant uses the new version of the software and modifies the teaching case such that it can be browsed as planned. The authoring process iterates around Steps 5, 6, 7, and 8 until the authors are completely satisfied with the results.
9. The final approval committee, which includes all the relevant coordinators and authors, reviews each case, and makes joint suggestions for further modification if required. The teaching case is modified accordingly, and Steps 5, 6, 7, 8, and 9 are iterated once more until all parties concerned are satisfied with the results.
10. The teaching case is then piloted on a focus group of students in order to collect their opinions and to make further modifications if necessary. Finally, the teaching case is implemented in the curriculum in the medical center for the use of students, or in educational programs for the use of residents and specialists.
11. To enable the authors to assess a student's performance, his interactions with the "HINTS" system are recorded and then analyzed in order to compute relevant performance statistics. The teaching cases and the "HINTS" system can be further modified to meet any new requirements as a result of this assessment. Therefore, the feedback inputs to Steps 5, 6, 7, 8, and 9 for the further development of the system.

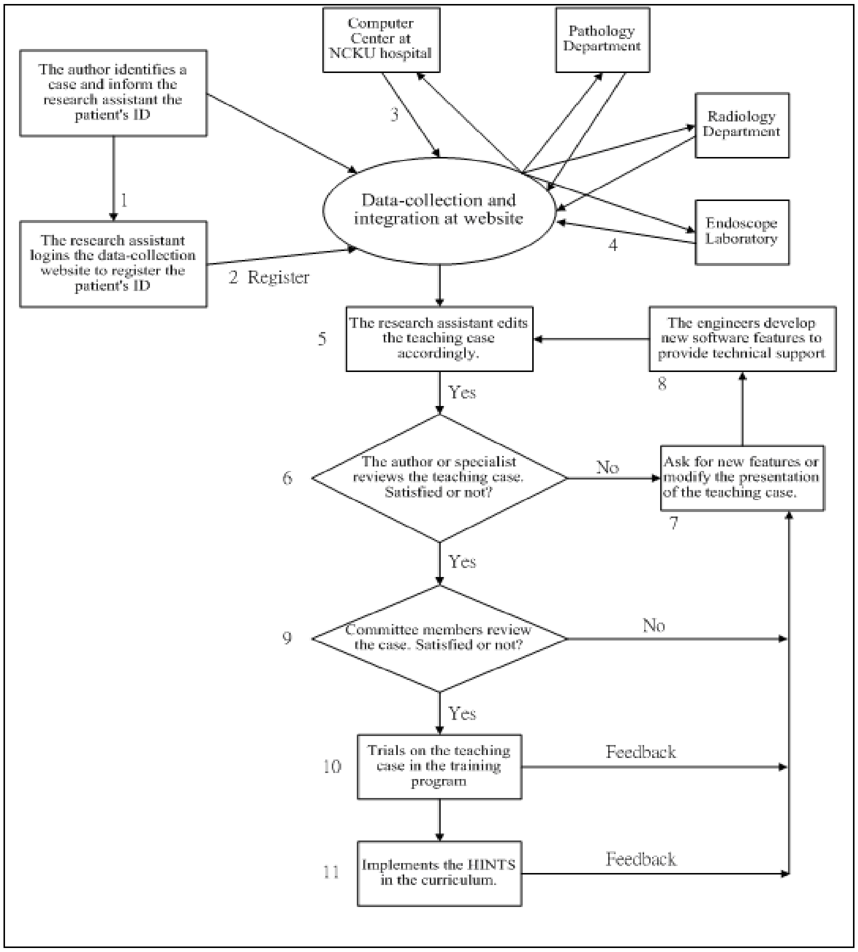


Figure 2. Flow of teaching case development

The Engineer's Perspective

The prototype system contains three databases to implement the document-view architecture, including (a) a user profile database which includes data related to each user, including name, major (e.g. internal medicine), level of sophistication (e.g. intern, specialist, or student in medical school), etc. (b) a department-view-rule database (briefly described in the author's perspective subsection) which stores the case template information and has a number of fields, including department name (or student major, e.g. internal medicine), case template ID, section names in the case template for this department. (c) a presentation database having a number of fields, including user level, department name (or student major, e.g. internal medicine), section name, operation mode, e.g. interactive mode or plain mode, and a presentation function which implements how each section in a teaching case should be presented based on the user level and major. The above mentioned information is used as indexes to retrieve the presentation function which implements how a particular section in a teaching case is to be presented. Using the provided tools, the user profile database is populated by the system administrator, and the other databases by the authors and engineers, before the case is made available on the website. The architecture of the system is shown in Figure 3. In order to ease the management of all the multimedia documents associated with the teaching cases in the system, all the multimedia documents are stored in a teaching case database.

Figure 1 show how the process works. (1) User profile process: when a user uses the web browser and logs-in into the system, the system first accesses the user profile database to retrieve the relevant user major and user level; (2) View-rule process: when the user activates a particular teaching case for interactive browsing, the system retrieves the corresponding case template and the section names for the particular department view stored in the department-view-rule database. At this point, the system is ready to present the teaching case to the user in the particular department view. On the right-hand side of the browser window shown in Figure 1, the system shows all the section names in the case template for this particular department view; (3) Decision of the presentation process: when a section is clicked, the presentation function for this section is retrieved from the presentation database by using the first four fields of the presentation database as the key. The system retrieves the contents of the section from the teaching case database, and uses the presentation function to present the section to the user.

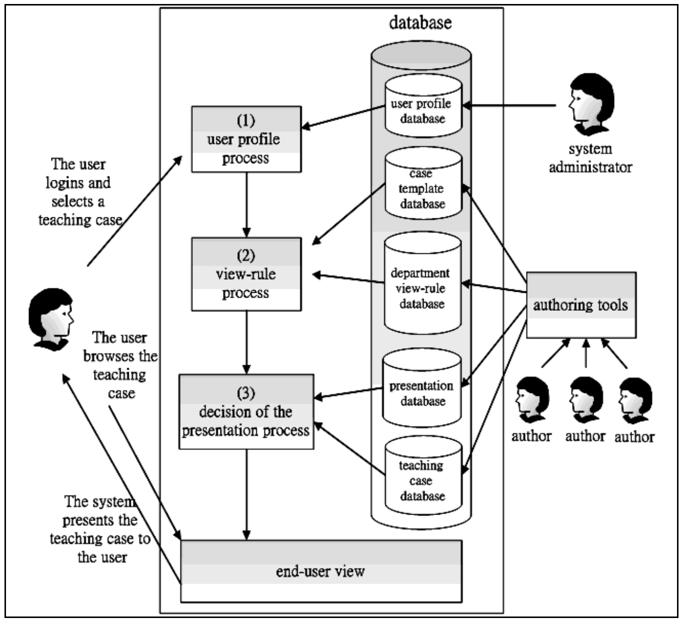


Figure 3. The architecture of the system

RESEACH METHOD

Research Design and Research Structure

This study is an exploratory research based on cross-sectional research design, and uses structural questionnaires as the research tool for data collection. The proposed system has been installed in the medical center, Taiwan for trial purpose. More than 150 students ranging from the 5th to 7th grade (equivalent to 1st to 3rd grade students in a medical school of the American medical education system) have had experience in using the system. For this particular study, the research subjects were 5th, 6th, and 7th year medical students at a medical university in Taiwan. Stratified random sampling was conducted based on the number of ratios of the medical students for each year, to extract 17 fifth year medical students, 12 sixth year medical students, and 11 seventh year medical students for a total of 40 medical students. All of them have enough basic medical science background to conduct the clinical diagnoses and currently have many practical training courses in the medicine department. Thus, 40 medical students underwent a four-week PBL Multiple Disciplines for Medical Education instruction experiment. The “PBL Multiple Disciplines for Medical Education system and learning satisfaction questionnaire” was administered to explore the satisfaction of medical students in using PBL multiple disciplines for medical education. The questionnaire design was based on the research objectives, literature review, and many years of instructional experiences of medical educators and experts. The framework is shown in Figure 4. In the instruction experiment, in order to control the intervention of unrelated variables, according to the experiment control method by Best and Kahn (2006) and Van Dalen (1979), the five items of 1) initial behavior; 2) class hours; 3) instructional scope; 4) instructional tool; and 5) instructors were listed as the “control variables” for avoiding affecting experiment results. After the experiment instruction, the teaching medical doctors in four subjects (internal medicine, surgery, radiology, and pathology) were interviewed in order to understand the efficacy of this system in clinical medical education, as well as the improvement opinions.

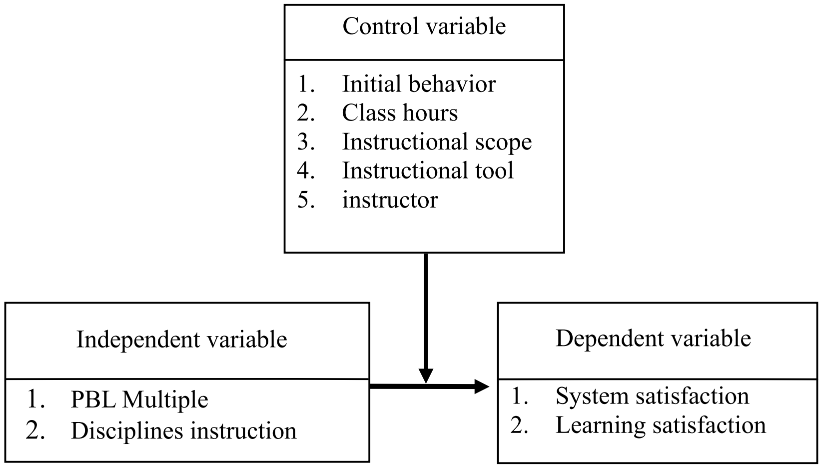


Figure 4. Framework of PBL Multiple Disciplines for Medical Education learning satisfaction

The PBL Multiple Disciplines of Medical Education System Learning Satisfaction Questionnaire
The questionnaire uses a Five-point Likert scale, ranging from 5 (highly agree), to 1 (highly disagree). In the first draft, there were 13 items. After reviewed by experts in the medical education field, and repeated modification for readability, one item was deleted, and the content of one item was revised. After expert validity testing, the formal questionnaire contains 12 items in total.

Pilot study
In terms of testing validity, expert content validity was used. Experts carefully tested whether the items could represent the behavioral aspects to be tested (Gronlund and Linn, 1990). Purposive sampling was used to extract 30 medical students for pre-test, and the data were analyzed with item analysis and factor analysis. Based on the results, one item was deleted. The final questionnaire contained 12 items, which was used to establish the construct validity of the scale. After expert validity and construct validity evaluation, the scale underwent reliability testing by Cronbach α coefficient to analyze internal consistency of items in the same dimensions. The Cronbach α coefficient is 0.905, which reaches the requirement of reliability of over 0.7 (Nunnally, 1978).

RESULTS AND DISCUSSIONS

The objective of the courses is to help medical students learn the skills of how to face a real patient, order laboratory test, make a diagnosis, and give treatment to the patient. At the beginning (the first classroom lecture for a case), the instructor gave the students some background knowledge about the particular case in the classroom. Then, the students browsed through the case including reading through the basic information and chief complain sections in the HINTS, specifying which part of the patient body should be examined, what questions should be asked, and what laboratory test should be ordered to get more information and insight about the patient's status from the HINTS, and finally gave their final diagnoses for the exercise. The following survey data were collected right after the students finish their browsing of the teaching cases. In the second classroom lecture, the instructor and students discussed their results computed by the HINTS and experiences about the teaching case.

After administering the questionnaires, the retrieved questionnaires were coded, encoded, input into a computer. SPSS 12.0 for Windows was used for descriptive statistics to evaluate the satisfaction of medical students in three grades after receiving the PBL Multiple Disciplines for Medical Education instruction. The results are shown in Table 1.

Table 1. Summary of respondent feedback

Questions \ Grade	5^{th}		6^{th}		7^{th}	
No. of students	*N*=17		*N*=12		*N*=11	
M (Mean Value) and *SD* (Standard Deviation)	*M*	*SD*	*M*	*SD*	*M*	*SD*
The system operational interface is relatively easy	4.18	0.18	4.5	0.27	4.55	0.27

The teaching cases in the system are beneficial to your learning in clinical practical training	3.65	0.26	4.4	0.27	4.63	0.25
You are satisfied with the learning flow designed in the system	4.06	0.18	4.25	0.22	4.45	0.27
After learning, you have better understanding of the learning objectives of clinical practical training	4.4	0.23	4.4	0.27	4.55	0.27
In the future you are still willing to use this system for the learning of clinical practical training	4.47	0.26	4.6	0.30	4.64	0.25

Table 1 shows that medical students agreed on the user-friendliness of the system operating interface. The 6th and 7th year medical students show greater agreement than 5th year medical students that the teaching cases in the system are helpful to the learning of clinical practical training. All medical students are satisfied with the learning flow design in the system, and believe that after learning, they have clearer understanding of the learning objectives of clinical practical training. For instance, Student A stated in interview, "generally, medical students identify with the system, and everyone thinks that this system is instrumental in clinical practical training. After all, it is impossible to face so many cases in actual courses, and these teaching cases have important learning points, and have important referential value for future patients as well." Students are willing to use this system for clinical practical training in the future. However, this system is not perfect. For instance Professor B indicated that "even though this system cannot fully simulate the patient context, this is a very important platform for cases that have learning value, and can be seen as a knowledge bank for clinical medicine."

Then, descriptive statistics are used to evaluate students' satisfaction after receiving PBL Multiple Disciplines for Medical Education instruction. The results are shown in Table 2. Table 2 summarizes the student responses to a series of questions posed by the current researchers. The students have also made a variety of comments after using the various teaching cases in the system. The results of this study are summarized as follows (some of the results are provided by the instructors):

As we expected that all the students felt that the teaching cases with multiple views are much more interesting and give them more integrated view of the cases than the isolated teaching cases. The responses from the students in different grades do not show any significant difference about the "HINTS" system.
All the students agree that the system can significantly improve the skills for real clinical cases as shown in the Table 1. The standard deviation values are very small. This implies that the students do have consensus on the responses about the system.

This research work also provides an opportunity for the experts (authors) in various medical disciplines to get together and discuss how the teaching material should be presented to the students. The authors also get an opportunity to learn more about how other experts view the same case and to further sharpen their medical knowledge in general.

Table 2. Summary of respondent feedback

Questions \ Grade	5th		6th		7th	
No. of students	*N*=17		*N*=12		*N*=11	
M (Mean Value) and *SD* (Standard Deviation)	*M*	*SD*	*M*	*SD*	*M*	*SD*
The practice can help the individual's learning	4.35	0.48	4.33	0.47	4.27	0.45
The practice can simulate the real clinical environment	4	0	4	0	4	0
The operation of the teaching cases was straightforward	3.88	0.47	3.91	0.49	4	0.43
The system can improve the capability of the clinical service	4.11	0.32	4.08	0.28	4.18	0.39
Using the "HINTS" to present all the teaching cases in the clinical training courses	4.18	0.38	4.08	0.28	4.18	0.39
The teaching cases with multiple views are much more interesting, and give users a more integrated view of the cases than standalone teaching cases	4.53	0.5	4.5	0.5	4.63	0.48

Finally, after the experimental instruction, professors from four specialties were interviewed, including internal medicine, surgery, radiology, and pathology. The interview inquired their opinions after using the system and their suggestions on improvement. Medical education in the first four years is foundational medical education, and the last three years is clinical/medical practical training. Clinical/medical practical training primarily focuses on how to face patients and how to make correct diagnoses and treatment, and especially the thinking process involved. However, when doctors face patients, they frequently need the assistance of doctors in other specialties to make the correct diagnosis. For instance, if the patients need imaging (X-ray, CT/MR, etc.), they need the help of radiologists to read the data. When patients need surgery, surgeons need patient histories and related testing (examinations) data for pre-surgery evaluation to plan for the surgical process and post-surgical care. Thus, the training of a doctor requires not only professional clinical knowledge, but also the ability to understand the diagnosis of other specialties and the processes in involved, but current medical education platforms tend to lack these learning mechanisms.

The Multiple Disciplines mechanisms constructed by this study can supplement and strengthen these shortcomings. In the interview, internal medical Professor C affirmed the effect of Multiple Disciplines mechanism on the learning of clinical cases, suggesting that "medical education is based on a doctor-patient relationship that is patient-centered. Doctors need to have full understanding of the diagnosis process and method of different specialties, before they can make the correct medical treatment. The Multiple Disciplines mechanism designed in this study should be able to enhance the abilities of medical students in this regard. After the clinical courses, medical students do have better understanding of the teaching cases." Surgeon Professor D also approved the Multiple Disciplines mechanism and the processing flow, suggesting that there should be more multimedia interactive functions for even better results. He said "this is a good mechanism. Medical students can understand the process of case patient treatment, especially the clinical treatment of different specialties. I suggest that in the future the surgical plan and process should have more lively multimedia interaction, such as computer surgeries and videogame interactive mechanisms. This should be more helpful to medical students." In the trend of emphasizing patient privacy, radiology Professor E expressed that "in the context of emphasis for patient privacy, providing this PBL learning system is an important contribution to clinical/medical education. If radiology can make 3D reconstruction of the CT/MR imaging, learning effect would be better." Pathologist Professor F made the following suggestions for the teaching cases in this system, that they should be matched with the needs of medical students in different years and levels, "editing of teaching cases can use the document-view mechanisms to present teaching cases in different disciplines, and can indeed elevate the effects of clinical learning. It is suggested that in the future there should be major editing of these integrated teaching cases, dividing them into easy, medium, and difficult. Students from different years and levels (4, 5, 6, or interns and specialty doctors) can learn differently."

Thus, the interview results show that the professors all affirmed the effects of clinical case learning for this system. The Multiple Disciplines mechanism can indeed enhance medical students' overall understanding of the diagnosis and treatment in different specialties. Suggestions on strengthening multimedia interaction or teaching case can be used as a reference for future system updates.

CONLUSIONS AND SUGGESTIONS

In order to carry out the concept of integration of various department views of Web-based PBL teaching cases, an interactive PBL teaching case system is implemented through using the document-view technique, which allows one document with many different views. The system was implemented with a rule-based mechanism that is different from those documented in the literature. According to the results of the study, the system turns out to be very successful and efficient. The users would indeed feel strongly about the way the cases are presented to them. Additionally, the users show great interest in using the system. The system also gives the students stronger feeling about how medical knowledge is integrated into the real clinical settings. The findings of this study can also benefit the medical school professors and clinic physicians in terms of teaching activities as well as research on medicine.

The process of collecting and editing teaching materials of multiple disciplines is very complicated. Thus, it is very important to establish a feasible and effective online system for collecting case teaching materials from different disciplines. This system will enable the medical school professor's assistant to gather and compile useful teaching materials for them to verify. This process will ease medical professors' teaching loading as well as increase their willingness to compile teaching case materials. In doing so, the case teaching and learning transaction will become more effective and efficient. Finally, participants suggest shortening the learning time of each case from average 44 minutes to 30 minutes. That is, in the future, the content of teaching materials should be simplified as long as the learning point is reached in order to enhance the participants' learning motivation.

ACKNOWLEDGEMENTS
The authors wish to thank the project was supported by a grant from National Science Council, Executive Yuan, ROC (NSC-99-2511-S-366-002).

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