Application of an Interactive Computer Program to Manage a Problem-Based Dental Curriculum


Abstract: Managing the change from traditional to problem-based learning (PBL) curricula is complex because PBL employs problem cases as the vehicle for learning. Each problem case covers a wide range of different learning issues across many disciplines and is coordinated by different facilitators drawn from the school’s multidisciplinary pool. The objective of this project was to adapt an interactive computer program to manage a problem-based dental curriculum. Through application of a commercial database software—CATs (Curriculum Analysis Tools)—an electronic database for all modules of a five-year problem-based program was developed. This involved inputting basic information on each problem case relating to competencies covered, key words (learning objectives), participating faculty, independent study, and homework assignments, as well as inputting information on contact hours. General reports were generated to provide an overview of the curriculum. In addition, competency, key word, manpower, and clock-hour reports at three levels (individual PBL course component, yearly, and the entire curriculum) were produced. Implications and uses of such reports are discussed. The adaptation of electronic technology for managing dental curricula for use in a PBL curriculum has implications for all those involved in managing new-style PBL dental curricula and those who have concerns about managing the PBL process.

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In the past decade, dental education has been under pressure to change in the face of rapid expansion of knowledge, enhanced community expectations, and stakeholders’ concerns. There have been repeated calls for a more contextual environment for student learning and to foster lifelong learning within dentistry. New curricula, often based on principles of interactive and problem-based learning (PBL), have been introduced in a variety of medical and dental schools globally in an attempt to address these demands. In some situations, traditional didactic teaching curricula have been replaced entirely with student-centered learning (“pure PBL”), whereas others have adopted hybrid forms integrating both didactic and PBL approaches to varying degrees.

Managing the change from a teacher-controlled educational environment to student-centered learning is complex, and there has been a great deal of concern among both educators and students about implementing the PBL process. In PBL, problem cases are employed as the vehicle in the learning process; each case covers a wide range of different learning issues across many disciplines, and students work in small groups that are coordinated by facilitators drawn from an institution’s multidisciplinary pool. Concerns about documenting and tracking exact content coverage in the PBL format have been raised; the question, in other words, is how to determine when and where specific learning issues are addressed and assess how much time is dedicated to them. In addition, there are manpower concerns about the feasibility of employing PBL curricula, the actual amount of manpower needed, and the appropriate skill mix to facilitate multidisciplinary cases. Unlike traditional didactic teaching, PBL curricula cannot address these concerns easily since certain faculty do not cover specific discipline-based topics at set points in time throughout the curriculum.

In the Faculty of Dentistry at the University of Hong Kong, a new PBL curriculum was implemented year by year starting in 1998. The learning of the clinical dental sciences, the supporting biomedical, social, and behavioral sciences, and the relevant clini-
Cal medical sciences takes place in a fully integrated manner. Knowledge is acquired through the study of over seventy problems throughout the five-year course. Clinical learning takes place mainly over four years parallel to problem-based learning, with problems providing the necessary knowledge and background for clinical learning. Clinical skills are taught initially in a simulation laboratory, and specific problems are timed to link in with these activities. Managing a program comprising 950 small-group PBL tutorials annually with over 100 staff contributing as facilitators is a complex task. Thus, we sought to apply an interactive computer application program to coordinate, monitor, and document this new type of learning in an attempt to illustrate how such curricula can be managed appropriately.

Methods: Computer Database Setup

There are many commercial software programs available to manage curricula. One program widely used by dental schools in the United States is Curriculum Analysis Tools (CATs) (see Figure 1). This software was initially designed by a consortium developed by the American Association of Dental Schools (now the American Dental Education Association) to manage its dental curricula. Responsibility for maintaining the CATs program has since been transferred to a commercial software company. The software package allows an overview of all courses in a curriculum and enables course directors to organize and analyze curriculum content. It also provides a linkage between courses and student competencies.

With this program, we deduced ways of inputting information from our PBL curriculum that allowed us to construct a database within CATs for managing the PBL process as follows. First, each component of the PBL curriculum was entered as a separate course (i.e., each problem case) and listed in the roster of courses on CATs (Figure 2). Following on, additional information was provided about each course (problem case) in relation to two aspects: contact distribution and basic information. Within contact distribution, information about contact hours (hands-on time) and noncontact hours (self-directed learning) was in-

![Figure 1. Curriculum Analysis Tools (CATs) program](image)
putted relating to a list of categories (i.e., amount of
time spent in group learning and the amount of time
spent on independent study) (see Figure 3).

Five attributes of each problem case were en-
tered as “basic information” for each problem case.
First, competencies covered by the specific course

Figure 2. Data should be entered for each problem case listed as a separate course

Figure 3. Contact distributions per problem case (contact and noncontact hours)
(problem case) were inputted (Figure 4). By inputting all competencies of the curriculum into the database system before entering data about each problem case, it was possible to select the competencies covered by each problem case, thereby saving inputting time.

Second, specific basic information, called “key words,” was inputted about the scope of the intended learning from each problem case. Key words are the anticipated learning outcomes; they can be chosen from a list available in the CATs program or they can be generated. Further clarification of the particular aspects of a topic can be entered by selecting modifiers. For example, the modifiers used in the topic “space analysis” may include dental aspects of space, loss of space, sequelae of space loss, etc., as demonstrated in Figure 5. The key word database in the CATs program contains more than 50,000 dental-related terms mapped into thirty-eight domains and 500 topics. New key words and new taxonomy links were created for the purpose of developing our curriculum database, and we entered five to ten learning issues arising from each of our problems.

Third, information relating to “participating faculty” was inputted, providing information about the facilitators involved in each problem case as shown in Figure 6. By inputting a list of all faculty staff into the CATs database system before entering curriculum data, it was possible to select the staff involved in each problem case, thereby saving inputting time.

Next, information relating to “independent study activities” was inputted, where frequently the type of study was library research (Figure 7). Finally, information relating to “homework assignments” associated with the problem case was inputted; this was usually a prepared product designed to reinforce learning (Figure 8).

In a similar way, further information needs to be inputted for the clinical skill courses that take place in the simulation laboratory or polyclinics to obtain full coverage of all aspects of the curriculum in the database. Polyclinics are oral health delivery environments in which patients receive comprehensive periodontal, restorative, and prosthetic care delivered by students under the supervision of teachers from the various disciplines concerned.

Results

After all the curriculum data is inputted, outcomes or results can be generated in the form of export reports that can be produced as RTF files or...
Figure 5. Basic information for each problem case: key words

Figure 6. Basic information for each problem case: participating faculty
HTML files (Figure 9). Four types are available: general reports, keyword reports, competency reports, and clock hour reports. These reports can be generated at three different levels: for each individual unit of the curriculum, i.e., each component or problem case; for each year; and for the overall curriculum (combining all years). General reports produce an overall summary of participating faculty, competencies covered, learning issues covered (key words), and time spent. An example of a general report for a curriculum component appears in Figure 10.

Key word reports can be generated to display all key words relating to the learning issues covered in one problem case during one year or throughout

Figure 7. Basic information for each problem case: independent study

Figure 8. Basic information for each problem case: homework assignment
the curriculum. Figure 11 illustrates a key word report at a problem case level. In addition, it is possible to report by problem case, year, or the whole curriculum where certain key words (or learning issues) are covered. Figure 12 illustrates a report on a search of the keyword “enamel.” The report illus-
trates where this topic was covered and what specific aspects were covered, as illustrated by the modifiers in the report.

Competency reports provide information on where and what competencies were covered relating to each problem case, each year, or within the overall curriculum (Figure 13). Clock hour analysis/reports provide information about the actual time spent on a case, or spent yearly, or on the overall learning throughout the whole course. These reports are derived from the input of both contact and noncontact hours (Figure 3).

**Discussion**

Managing new forms of dental curricula such as PBL presents many challenges because of the different vehicles for learning, different ways in which academic staff are employed, and ultimately different objectives of the courses. In the first instance, in the transition to such curricula, it is important to ensure that the process or structure of the curriculum is fully in place. Frequently, this will necessitate reliance on some form of software because of the complexities of this approach to learning.

The software we employed, Curriculum Analysis Tools (CATs), was a useful tool to assist in managing our problem-based dental curriculum although not without intensive modification and application. The availability of an existing key word database of more than 50,000 dental-related terms mapped into thirty-eight domains and 500 topics was time-saving, particularly given the laborious process of inputting all learning issues (key words) for the entire curriculum. Furthermore, the ability to add other key words or taxonomy links was useful because in many situations it is necessary to add new key words and links that relate to the local context of a particular dental curriculum. In addition, the ability to input lists of faculty staff and competencies covered into the database system and select from it as appropriate when inputting course/case data was time-efficient.

The reports that can be generated from such a software package are useful on many fronts. General reports, for example, can be useful in providing

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**Figure 11. Key word reports at a problem case level**

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<table>
<thead>
<tr>
<th>Number</th>
<th>Setting</th>
<th>Domain / Topic</th>
<th>Concept</th>
<th>Keyword</th>
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<td>ilestone</td>
<td>Dental / Medical Emergencies / Acute Traumatic Injury</td>
<td>Confusions</td>
<td>Bruise</td>
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<tr>
<td>DE61014</td>
<td>ilestone</td>
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<td>Confusions</td>
<td>Cardiovascular System</td>
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<td></td>
<td></td>
<td></td>
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<td></td>
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an overview of the curriculum (set at a course, year, or the overall curriculum level), which can assure individual course directors about the content of the curriculum and are also useful for accreditation purposes. Likewise, reports on competencies covered can be useful for accreditation procedures and site visits from state boards/dental councils, external reviewers, etc.

One of the most useful applications of the program is its ability to provide information on which specific learning topics have been addressed and to what depth at specific times in the curriculum. This is accomplished by combining key word reports with clock hour reports. This technique provides an opportunity to create blueprint examinations accordingly. This is particularly important in PBL curricula because of the integrated nature of the learning, whereby a particular topic may be covered at different times in the course in relation to different aspects of the curriculum and to different depths. A map of learning topics that have been covered in the problem cases facilitates knowing what knowledge students can be expected to have at any particular point in the curriculum.

Reports relating to participating faculty can provide a quick and easy summary of human resource utilization. This is useful for both administrators in resource planning and individual dental teachers in reporting their contribution to teaching and learning within the school.

The next phase in the application of an interactive computer program to manage a PBL dental curriculum should be to develop a strategy to link the outcomes to various components of the curriculum. This could facilitate greater understanding of the link between the process and outcomes in dental education. The same company that markets CATs has produced a computer software package called CourseEval that may be able to accomplish this goal. The next step in the evolution of the PBL curriculum management strategy is to interlink both software programs.

![Table](image)

<table>
<thead>
<tr>
<th>Number</th>
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<th>Concept</th>
<th>Keyword</th>
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Figure 12. Reports on a key word (whole curriculum)
Conclusion

This article described the implementation of an electronic technology for managing traditional dental curricula that was adapted for use in a PBL curriculum. Use of this computer-based curriculum management system appears to have numerous positive attributes for monitoring, coordinating, and documenting PBL dental programs and thus may alleviate some of the concerns that have been expressed about managing the PBL process.

Acknowledgment

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REFERENCES